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ABSTRACT

This text, based on the National Search and Rescue (SAR) Plan, was prepared to provide a course of study on common procedures for SAR operations so that any basically qualified person in the U.S. Coast Guard Auxiliary can effectively accomplish a SAR mission and act as on-scene commander if required. There are 13 chapters: Introduction to Search and Rescue, The National SAR Plan, The Search and Rescue Incident, Rescue Coordination Center, SAR Facilities, Search and Rescue Planning, Search Area Coverage, Search Patterns, SAR Communications, SAR Seamanship, SAR Administration, Public Information and Legal Aspects of SAR, and SAR Drills. A glossary and supplementary graphs and tables are appended. It is noted that regulations, procedures, and policies that apply to SAR on a national basis are explained in detail, but that individual districts have established supplemental methods which should be considered in teaching this subject. (HD)

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SEARCH AND RESCUE

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DEPARTMENT OF TRANSPORTATION / UNITED STATES COAST GUARD

SEARCH AND RESCUE
IN THE
UNITED STATES COAST GUARD
AUXILIARY

DEDICATION

To the thousands of U.S. Coast Guard Auxiliarists who have braved the unknown dangers of a search and rescue mission and who know, so well, the need for personnel trained in the knowledge of saving lives at sea.

TABLE OF CONTENTS

Chapter		Page
I	Introduction to Search and Rescue	1
II	The National SAR Plan	3
III	The Search and Rescue Incident	7
IV	Rescue Coordination Center	13
V	SAR Facilities	15
VI	Search and Rescue Planning	17
VII	Search Area Coverage	23
VIII	Search Patterns	29
IX	SAR Communications	45
X	SAR Seamanship	49
XI	SAR Administration	57
XII	Public Information and Legal Aspects of SAR	61
XIII	SAR Drills	65
Appendix	Glossary, Tables and Graphs	67

PREFACE

This text, based on the National Search and Rescue (SAR) Plan, was prepared to provide a course of study on common procedures for Search and Rescue (SAR) operations so that any Basically Qualified Auxiliarist can effectively accomplish a SAR mission and act as On-scene-Commander is required. The procedures and techniques herein advocated in conducting SAR operations should be followed. However, they should be tempered with judgment, having due regard for the conditions existing at the time which may require deviation and resourcefulness. No provision of this course shall be construed as a barrier to prompt and effective action to relieve distress whenever and wherever found. The regulations procedures and policies that apply to SAR on a national basis are explained in detail. Individual districts have established supplemental methods which should be considered in teaching this subject.

The original text for Auxiliary Search and Rescue training was excerpted from the National SAR Manual in 1967 by Past National Staff Officer Robert A. Pumphrey and edited by PDCP Benjamin Rivis, Fifth District. To them must go the editor's thanks for setting the ideas into print so that we could try to improve on them. Special recognition also must go to Commander J. E. Rivard, Jr., USCG and the faculty of the National Search and Rescue School, Governor's Island, N.Y.; to Commander George Wagner, USCG; National Commodore Harold B. Haney, USCG AUX; and Department Chief, Education, Ralph Wright, USCG AUX.

In addition, I would like to thank Mrs. Pearl Van Beveren for typing the manuscript.

Cocoa Beach, Florida
1973

Ernest A. Baldini
Past District Commodore
USCG Auxiliary

CHAPTER I

INTRODUCTION TO SEARCH AND RESCUE

DEFINITION

Search and Rescue (SAR) is defined as the employment of available personnel and facilities in rendering aid to persons and property in distress. The development of the SAR concept as a planned undertaking is of fairly recent origin, although the recognition of the moral obligation to assist persons in distress dates back to ancient times. The rescue of military personnel in distress has become an integral and important part of military operations. The armed forces have traditionally accepted, to the extent practicable, a moral or humanitarian obligation to aid non-military persons and property in distress. Civil agencies and volunteer organizations, such as the U.S. Coast Guard Auxiliary, have enlarged the capabilities for search and rescue.

BASIC PROBLEM

Members of the U.S. Coast Guard Auxiliary are volunteers and, as such, are not expected to present the kinds of facilities and preparedness that are characteristic of the military and civil agencies. Nevertheless, Auxiliarists should understand where they fit in the overall SAR organization, what limitations are placed upon them and how they are to respond to the various distress notifications they will encounter.

The knowledge areas in search and rescue that the Auxiliarist must become familiar with are:

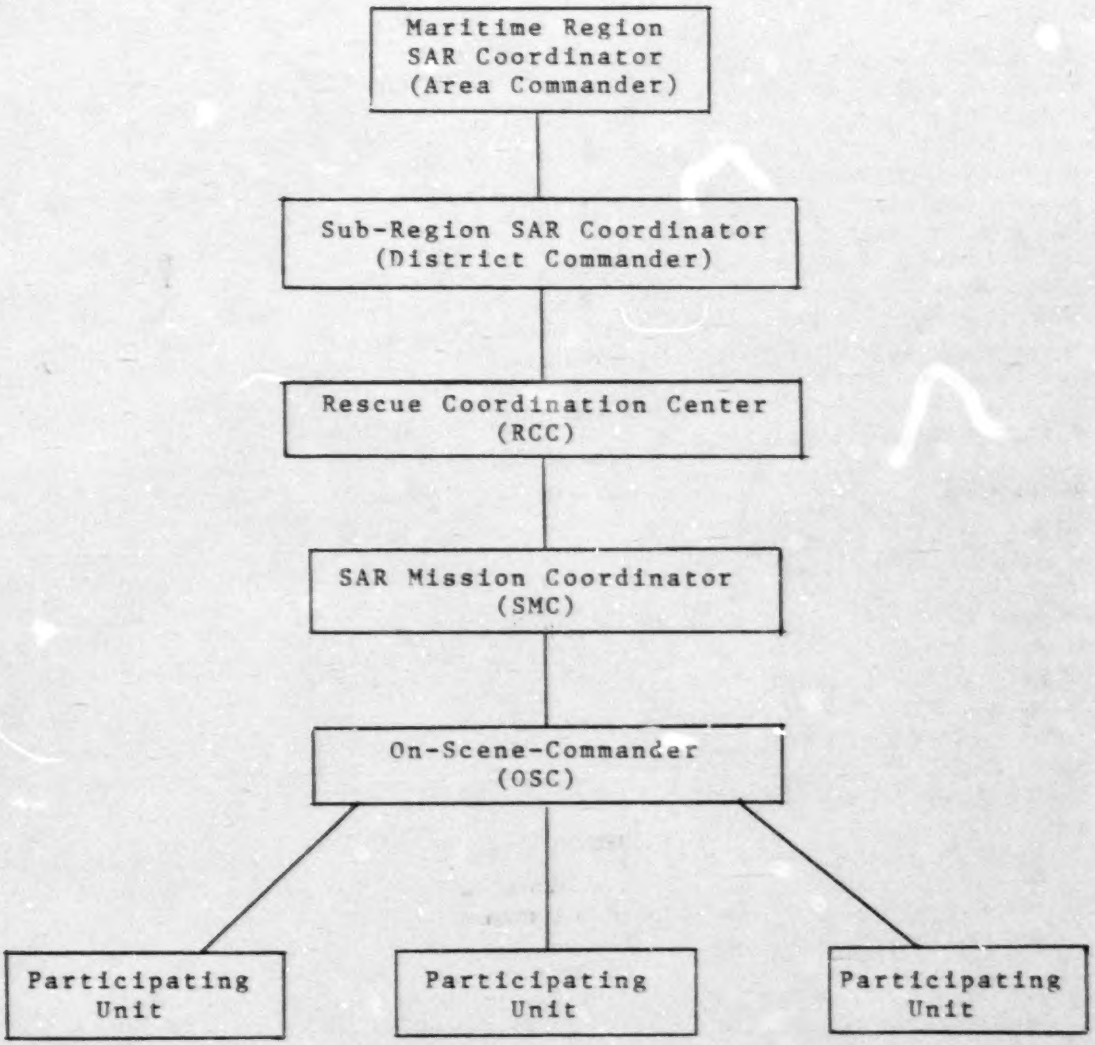
1. Distress notification from Coast Guard or public.
2. SAR mission acceptance from the Coast Guard.
3. Determination of DATUM.
4. Determination of search area.
5. Selection of search patterns.
6. Execution of search patterns.
7. Determination of area coverage.
8. SAR communications and SITREPS.
9. Liaison file and log maintenance.
10. Release of information to families or agents of distressed persons.
11. Release of information to news media.
12. Reporting SAR incident information to Coast Guard at end of mission.
13. Execution of duties of On-Scene-Commander.
14. Responsibilities and information requirements of SAR Mission Coordinator.
15. SAR seamanship.

The above list of knowledge items is, of course, not complete. In the following chapters, suggestions and lists will be presented which will provide the student with additional ideas and requirements for his SAR training.

A SAR specialist must always maintain an unbiased attitude, realizing that a search and rescue incident may NOT fit a formula; that information provided by others regarding a SAR incident may be erroneous, garbled, transposed, confused, or embellished; that distress victims may NOT use intelligent methods to assist in their rescue; and that distress victims, when rescued, are often embarrased or distraught and, as a result, are often critical of their rescuers.

The student beginning SAR study should stop and think for a moment—how much training would he want the person looking for him to have?

COAST GUARD SAR ORGANIZATION



Chapter II

THE NATIONAL SEARCH AND RESCUE PLAN

The National SAR Plan, as presented in the National SAR Manual CG-308, is a document that provides an overall plan for the control and coordination of all available facilities for all types of search and rescue operations. A single federal agency, through an appropriate Rescue Coordination Center, coordinates all SAR operations in any one area. The National Plan establishes three SAR Regions and designates Regional SAR Coordinators as follows:

1. The Inland Region under the Air Force
2. The Maritime Region under the Coast Guard
3. The Overseas Regions under the Overseas Unified Commanders.

Regional SAR Coordinators are responsible for organizing existing agencies and their facilities, through suitable agreements, in a basic network for rendering assistance both to military and non-military persons and property in distress and to carry out the United States' obligations within their specific SAR regions.

U.S. COAST GUARD

The Coast Guard has specific statutory authority and responsibility for developing, establishing, maintaining and operating rescue facilities and for rendering aid to distressed persons and property (i.e., personnel, ships, and aircraft, both military and civil) on, over and under the high seas and waters subject to the jurisdiction of the United States and may render aid to persons and protect and save property at any time and at any place at which Coast Guard facilities and personnel are available and can be effectively utilized. In carrying out its search and rescue function, the Coast Guard may utilize the facilities and personnel of the Coast Guard Auxiliary together with its own facilities and personnel in performing SAR missions.

MARITIME REGION

The Commandant, U.S. Coast Guard has divided the Maritime Region into *two major areas* of responsibility –the Atlantic Maritime Region and the Pacific Maritime Region. Commander, Atlantic Area, U.S. Coast Guard, has been designated Atlantic Maritime Region SAR Coordinator and Commander, Pacific Area, U.S. Coast Guard, has been designated Pacific Maritime Region SAR Coordinator.

In each maritime region, the Commandant of the Coast Guard has designated Commanders of the numbered Coast Guard Districts as *Sub-Regional or Sector SAR Coordinators* for their respective Coast Guard District.

Each subdivision of the Maritime Region is served by a Rescue Coordination Center (RCC) which is normally located at the headquarters of the designated SAR Coordinator.

RESPONSIBILITY OF SAR COORDINATORS

Primary responsibility for SAR Coordinators is defined as the duty of ensuring that the following steps are taken:

1. Prompt dissemination to interested commands of information about distress incidents requiring SAR assistance.
2. Prompt dispatch of appropriate and adequate rescue facilities.
3. Thorough prosecution of SAR operations until rescue has been effected or until it is apparent that further efforts would prove to no avail.

DUTIES OF SAR COORDINATORS

The following duties of SAR Coordinators are of interest to Auxiliarists:

1. Establish a Rescue Coordination Center
2. Ensure that a SAR plan is prepared and distributed to appropriate activities
3. Establish communications facilities
4. Designate SAR Mission Coordinators (SMC) for specific missions

SAR MISSION COORDINATOR

A SAR Mission Coordinator is an official designated by a Regional, Sub-Regional or Sector SAR Coordinator

for coordinating and controlling a specific SAR mission. Each SAR mission has a SAR Mission Coordinator; he may be either the SAR Coordinator, or a designated official in a better position to coordinate and control a particular SAR mission.

DUTIES OF SAR MISSION COORDINATOR

1. Obtain from the RCC Controller all pertinent information on the SAR incident.
2. Dispatch initial SAR facilities.
3. Initiate request for radar/search surveillance.
4. Obtain and plot fixes or bearings from all DF stations, including FCC and Navy DF nets.
5. Initiate "all ships" broadcast, if warranted.
6. Direct ground radio station to maintain communications, establishing a communication schedule, if necessary. Designate communication control and frequencies to be used.
7. Plot bearings and vector distressed aircraft to nearest suitable airport.
8. Determine weather and sea conditions.
9. Ascertain emergency equipment carried by distressed craft.
10. Determine search areas, select search patterns, and dispatch an organized SAR force.
11. Designate an On-Scene-Commander
12. Specify primary and secondary SAR frequencies.
13. Request additional SAR facilities.
14. Exercise SAR Operational control over forces assigned
15. Keep SAR Coordinator fully advised of SAR operations.
16. Brief SAR crews on target data, search areas, tactical call signs, OSC and primary and secondary frequencies.
17. Maintain a plot showing areas searched, percent of effective coverage, sightings and leads.
18. Alert vessels in area, requesting lookouts and listening watch on distress frequencies. Alert state and local agencies, if situation warrants.
19. Notify agents or command of the distressed craft of action taken and keep them informed of developments
20. Change search plans and radio frequencies as conditions dictate.
21. Obtain and evaluate all information on the SAR operation
22. Advise accident investigating authorities.
23. Debrief SAR crews and send situation reports (SITREPS) to appropriate SAR Coordinator(s) at the end of each operation. SITREPS should include identity of mission, areas searched, hours flown, number of aircraft sorties, number surface vessels used, square miles searched, and probability of detection of the target. SITREPS should be sent in numbered sequence.
24. When assistance is no longer necessary, de-alert and release SAR units and other activities involved
25. Notify agency or command of the distressed unit of the final results. Make a brief report of the SAR effort to the agency or command concerned.
26. Answer inquiries of news media in accordance with established policies.

Primary responsibility for SAR with SAR Regions, Sub-Regions and Sectors is assigned to the designated SAR Coordinators. Auxiliarists will normally be activated and directed by a SAR Mission Coordinator (SMC).

ON-SCENE-COMMANDER

An On-Scene-Commander (OSC) controls SAR operations and communications *at the scene* of SAR mission when control of the mission cannot be exercised effectively by the SAR Mission Coordinator. The OSC is subordinate to the SAR Mission Coordinator.

DESIGNATION OF THE ON-SCENE-COMMANDER

The SAR Mission Coordinator (SMC) shall designate an OSC when coordination at the scene is indicated and such coordination can be more properly effected by the OSC. The commander of the first facility on the scene to be in communication with the craft in distress, or with the Coast Guard, shall assume OSC duties pending designation of one by the appropriate SAR Mission Coordinator.

In designating an OSC, it is important that adequate SAR facilities be continuously available to the OSC so that he may effect direct control of on-scene operations and communications of assigned facilities. Frequent change of the OSC is not desirable. To provide continuity of command, any officer who is senior to the OSC, and who arrives subsequently, is not to take over command of operations unless:

1. Ordered to do so by the SAR Mission Coordinator, or
2. Such senior officer present decides that a change of command is essential. Change of OSC shall be reported to the SAR Mission Coordinator by the officer assuming OSC duties.

If the OSC is airborne he shall retain on-scene control until relieved either by unit designated by the SAR Mission Coordinator or when necessary by mutual

agreement with another on-scene unit. In the latter instance, the SAR Mission Coordinator shall be informed of the change by SITREP.

DUTIES OF THE ON-SCENE COMMANDER

1. Assume SAR operational control of all SAR facilities assigned to his search area. Coordinate their efforts within his area.
2. Establish communications with all SAR facilities within his area. Receive position reports and other pertinent reports.
3. Be responsible for communications and performance of SAR facilities.
4. Make regular position and other reports, as warranted, to the SAR Mission Coordinator via the established communication link.
5. Report weather and search conditions back to the SAR Mission Coordinator immediately upon arrival on the scene.
6. Ascertain endurance of SAR facilities within his area.
7. Provide details of the mission to participating facilities.
8. Assign specific search areas as necessary to SAR facilities within his own assigned search area and specify search patterns to SAR facilities. In short, search the area in the most efficient manner possible, taking into account the limitations and capabilities of SAR facilities, sea, weather, wind, visibility, and all the conditions on the scene.
9. Control and coordinate all SAR operations within his assigned area, keeping the SAR Mission Coordinator fully advised of weather, sea, and other conditions and developments.
10. Advise the SAR Mission Coordinator as various units arrive and depart the search area.
11. When necessary for the OSC to depart his assigned search area, turn over OSC to the senior officer present on-scene and notify the SAR Mission Coordinator accordingly.
12. OSC submits numbered Situation Reports (SITREPS) to Mission Coordinator. (See further details on SITREPS.)
13. Follow procedures and techniques outlined.

RESPONSIBILITY OF SAR PARTICIPANTS

The assignments of SAR responsibility among commands in no way affects the fundamental responsibility of any unit to initiate SAR operations as circumstances dictate. Independent action must, however, be reported immediately to the appropriate SAR Coordinator.

Because an Auxiliarist may be called upon to participate in a SAR operation at any time, all potential SAR participants are responsible for being familiar with standard procedures as set forth herein.

CHAPTER III

THE SEARCH AND RESCUE INCIDENT

A SAR incident, regardless of its magnitude, places in operation the specially prepared plans of a SAR Coordinator and the specifically designated facilities available. The entire scope of operations is aimed at the rescue of personnel and property in distress. Success depends on the prompt receipt of all available information pertaining to the incident, the rapid dispatch of rescue facilities to the mission scene, and the assistance that survivors may be able to give through the use of signaling aids which they have in their possession.

TIME ELEMENTS IN RESCUE OPERATIONS

The probability of finding survivors and their chances of survival diminish with *each minute* that passes after an incident occurs. All SAR units shall, therefore, take prompt and positive action so that no life will be lost or jeopardized through wasted or misdirected effort. Records have proven that the life expectancy of injured survivors decreases as much as 80% the first 24 hours following an accident while the chances of survival for uninjured survivors rapidly diminish after the first three days. These figures are averaged from overall experience. Naturally, individual incidents will vary with local conditions such as climatic conditions, ability and endurance of the survivors, and emergency equipment available.

STATUS OF SURVIVORS

It must be presumed that there are survivors in each incident who need medical aid or other assistance. It must be assumed that there is not even one able-bodied, logical-thinking survivor at the scene. Again, the records include numerous accounts where supposedly able-bodied, logical-thinking survivors failed to accomplish extremely simple tasks in basic logical order and thus hindered, delayed and even prevented their own rescue. The explanation is that shock following an accident is often so great as to cause those of strong mind to think and act illogically.

PROLONGED SAR OPERATIONS

All reasonable action shall be taken to locate distressed personnel, determine their status, and effect the rescue of survivors. Prolonged SAR operations after all probability of survival has been exhausted are uneconomical and not warranted. The decision to conduct such operations must be based on the probability of finding survivors or property.

LIMITING FACTORS

Auxiliarists are responsible for taking whatever actions they can to save life and protect property at any time and place where their facilities are available and can be effectively utilized. Nevertheless, there is a *limit* beyond which Auxiliary SAR participation and assistance is not expected and cannot be justified. Known and inherent risks must be carefully weighed against the mission's chances of success and the gains to be realized. *SAR personnel and equipment shall not be jeopardized unless lives are known to be at stake and the chances of saving those lives are within the capability of the personnel and equipment available.*

LEGAL ASPECTS

Civil laws and various national and foreign laws and regulations must be observed when conducting SAR operations. Compliance to this policy may be delayed only in extreme emergency involving the safety of life. All Auxiliarists coming under the jurisdiction of the National SAR Plan should have a knowledge and understanding of unfavorable legal situations that might involve damage claims against the U.S. Government. Legal aspects applicable to SAR missions which are discussed in Chapter XII are:

1. Crossing foreign borders and waters
2. Entering private property
3. Removal of human remains
4. Guarding and marking SAR wreckage

CONDITIONS WHICH MAKE A SAR INCIDENT

Different criteria have been established for each type of craft to determine whether or not the craft is involved in a SAR incident. When any of these criteria are known to exist, SAR action will be initiated.

AIRCRAFT INCIDENT

A SAR incident involving aircraft is considered imminent or actual when any of the following conditions exist;

1. The position of an aircraft raises doubt as to its safety.
2. Reports indicate that the operating efficiency of an aircraft is so impaired that a forced landing may be necessary.
3. An aircraft is overdue or unreported. Normally it is considered overdue when its position report is thirty (30) minutes late or when it fails to arrive within thirty (30) minutes of its estimated time of arrival and no communications can be established with it (15 minutes for jets).
4. An aircraft is reported to have made a forced landing or is about to do so.
5. The crew is reported to have abandoned an aircraft or is about to do so.
6. Emergency IFF/SIF (Transponder signal picked up by radar) is received at any station.
7. A request for assistance has been received or distress is apparent.
8. A radar station is painting a left-handed or right-handed triangular pattern.

SURFACE VESSEL INCIDENT

A SAR incident involving surface vessels is considered imminent or actual when any of the following conditions exist:

1. It is apparent that a vessel is in distress or has sent a request for assistance.
2. A vessel is considered overdue at its destination or a position report is overdue.

SUBMARINE INCIDENT

Submarine incidents differ from other SAR undertakings in that they are complex operations involving special equipment and procedures peculiar to underwater technology. Military submarine SAR is controlled by designated Naval Commanders. Civilian submersible SAR incidents are the responsibility of the Regional SAR Coordinator.

OTHER INCIDENTS

A SAR incident other than those mentioned in the preceding paragraphs is considered imminent or actual when it is apparent that personnel are in distress or when a request for assistance has been received.

SEARCH AND RESCUE EMERGENCY PHASES

When a SAR incident has been determined to exist, an emergency phase may be assigned to the incident by the SAR Mission Coordinator of the search craft involved. The report of the SAR Mission Coordinator should specify the emergency phase which has been assigned. Three phases may be assigned to a SAR incident. These, in order of progression, are:

1. Uncertainty Phase
2. Alert Phase
3. Distress Phase

UNCERTAINTY PHASE

Doubt exists as to the safety of a craft or its personnel because of lack of information concerning its progress or position or because of a knowledge of possible difficulties.

ALERT PHASE

Apprehension exists for the safety of a craft or its personnel because of a continued lack of information concerning its position or progress or because of definite information that serious difficulty would be unavoidable.

DISTRESS PHASE

Immediate assistance is required because of continued lack of information concerning the position or progress of the craft or because definite information has been received that the craft or its personnel are threatened by grave or imminent danger.

ALERTING AND INITIATION

Although all Auxiliarists are expected to inform the Coast Guard when they either observe or are aware of a SAR incident, notification will usually initiate from the Rescue Coordination Center (RCC) or a Group Commander. Aircraft controlling agencies, i.e., Flight Service Stations or Air Route Traffic Control Centers are also responsible for conducting a Preliminary Communications Search (PRECOM) when the incident involves an overdue aircraft.

PRELIMINARY COMMUNICATION SEARCH (AIRCRAFT INCIDENTS)

The Preliminary Communication (PRECOM) Search consists of contacting various stations and agencies to obtain information concerning the location and status of an aircraft for which an arrival or position report is overdue. The PRECOM search is initiated by agencies responsible for flight plans. Upon completion of the

PRECOM search, if results are negative, the incident becomes the responsibility of the Rescue Coordination Center.

1. *Federal Aviation Agency*. The Federal Aviation Agency handles flight plans within the United States as follows:
   a. Through its Air Traffic Control Centers (ATC) for aircraft on instrument flight plans.
   b. Through its Flight Service Stations for aircraft on visual flight plans.

EXTENT OF PRECOM SEARCH

The extent of the PRECOM search is limited to those stations that can be contacted through the normal communication circuits available to the ATC. The PRECOM search is accomplished in the following sequence and manner.

1. Contacting the destination and alternate to ascertain that the aircraft has not arrived.
2. Contacting the station of departure to ascertain that the aircraft actually departed, has not returned, and to confirm the correctness of the flight plan.
3. Contacting, through normal circuits, all stations along the proposed route of the aircraft in an attempt to establish contact with the aircraft or to ascertain that it has not landed prior to reaching its destination. (Stations which can be contacted only by commercial means are excluded and will be checked by the RCC in the Extended Communications Search, if necessary.)
4. Alerting through available circuits, all airfields, radio aids to navigation and radar and direction finding nets within the traffic control areas through which the aircraft's flight path has been conducted.

EXTENDED COMMUNICATION SEARCH (AIRCRAFT INCIDENTS)

RCCs are responsible for conducting the Extended Communication (EXCOM) Search. The purpose of this type of search is to obtain any information concerning an overdue aircraft from sources the ATC agencies could not check through their normal communication circuits. The EXCOM search is normally initiated upon completion of the PRECOM search at which time the incident is progressed to the Alert Phase. However, an EXCOM search may be initiated sooner if the situation dictates. The most expeditious and economical communication facilities should be used first; however, speed of accomplishment is essential and commercial facilities may be used as required. Method and sequence of conducting the EXCOM search is determined by the situation and time involved. If the EXCOM search yields negative results, the aircraft is declared "Missing" and the incident is progressed to the Distress Phase. Agencies and facilities to be checked during the search are as follows:

1. Radio aids to navigation, radar and direction-finding nets, and all airfields (military and civilian) along the aircraft's proposed route, that were not checked in the PRECOM search.
2. Other airfields in the general area where it is reasonably possible that the aircraft may have landed.
3. All other agencies and facilities capable of obtaining additional information or verifying information on hand. Forestry service units, law enforcement agencies, Civil Air Patrol and many other agencies provide assistance to complete the EXCOM search. Assisting agencies may be requested to conduct ramp checks of airfields where lack of communications or limited operating hours preclude direct contact by the RCC.

COMMUNICATIONS AND HARBOR CHECK

In the case of missing or overdue surface craft the RCC will conduct a Communication and Harbor check, similar to the EXCOM search for aircraft, before an incident is progressed to the Alert phase. This involves contact with marine interests such as marinas, bridge tenders, fishermen, etc. All harbor vessels must be checked by registration number. Nearby businesses such as restaurants and taverns must be called or visited. When the craft is overdue from a long sea voyage, SAR authorities in other countries may be requested to assist through their RCCs or through naval or other military channels. U.S. Embassy or Consular officials may also be contacted directly for assistance. In the latter case the U.S. Department of State should be made an information addressee on all messages.

SEQUENCE OF EVENTS

SAR operations will be initiated at any time a requirement for assistance is known to exist. Each SAR incident has its own specific circumstances of responsibility, assistance required and coordination and control functions. The basic procedures outlined in the following illustrate the normal progression of an incident from initial notification through to the beginning of the mission.

UNCERTAINTY PHASE

1. The incident is received by the Coast Guard and relayed to the RCC. The RCC Controller starts to record all pertinent data and completes his preliminary evaluation of vessel's plan, weather, and communication delays, to determine the urgency of the situation. At this point the RCC Controller may alert primary SAR facilities as the situation dictates.
2. The Communication and Harbor check is initiated and completed.
3. Should the check indicate that the missing vessel has moored safely, or is otherwise safely accounted for, all agencies will be advised immediately so the incident may be closed.
   Should the check prove to be unproductive and no communication has been established with the vessel in question, the Uncertainty Phase normally progresses to the Alert Phase.

ALERT PHASE

1. RCC Controller alerts air, sea and/or land SAR Facilities as the situation dictates.
2. Radar sites, ground communication stations, and direction finding stations are alerted for possible assistance
3. With negative results to this point the incident is usually progressed to the Distress Phase. An aircraft should be dispatched on a route search should sufficient apprehension exist for the safety of the vessel during the Alert Phase.

DISTRESS PHASE

1. At this time, as circumstances dictate the dispatch of SAR facilities, a SAR Mission Coordinator is designated. As such, he will prosecute the mission as the authorized representative of the SAR Coordinator.
2. Type and number of SAR units to be utilized is determined. Units are briefed and assume their responsibilities as delegated.
3. Radio stations are requested to maintain listening watches on specified frequencies for possible transmissions from the missing craft or personnel.
4. The operating agency or owner of the missing craft is notified.
5. SAR forces are dispatched and the incident progresses to a mission status.

RESCUE/RECOVERY

Upon finding the survivors or crash site, the search mission is over and rescue/recovery starts. The decisions and actions at this time have the greatest influence on the outcome of the rescue effort. The steps which should be taken, in order and with great care, are: 1) survival and flotation gear should be provided immediately by the search craft; 2) at sea, pickup can be made by ship, by helicopter, or seaplane, in that order of preference—techniques are usually a matter of airmanship or seamanship.

PSYCHOLOGICAL FACTORS

SAR personnel must be alert for certain psychological factors on the part of survivors which may negate the rescue attempt. Experience has shown that one of the following may happen during and after the rescue:

a. Due to grief, despair or the ordeal of survival, survivors may manifest irrational behavior such as neglect of personal safety, attempts at suicide or other irrational acts either during or after the rescue. Rescued persons should not be left alone for long if injured or showing signs of physical or mental exhaustion.

b. Panic may infect a group of survivors to such an extent that they not only jeopardize their rescue but also endanger the rescuers. Experience has shown, in such cases, that leadership among the survivors will greatly reduce this possibility.

INTERROGATION OF SURVIVORS

When the survivors have been rescued, the rescue unit should interrogate survivors with the following purpose in mind:

a. To determine if all survivors have been accounted for.
b. If all survivors are not accounted for, any leads as to what happened to the remainder.
c. Details of the emergency and survival procedures used that may be of value in future SAR cases.

All information about the survivors that may be of use in concluding the case should be immediately transmitted to the On-Scene-Commander and/or the SAR Mission Coordinator. Details of value to accident investigation authorities should be transmitted by written report.

TERMINATION OF SAR OPERATIONS

When certain that an emergency no longer exists, the SAR Mission Coordinator shall close the case. The RCC notifies all participating agencies and facilities of the termination of SAR operations and the reason therefore. A SAR incident or mission is not considered

closed until this action has been completed. Auxiliary units and facilities, upon termination of SAR operations, are required to provide all available incident information to the cognizant Coast Guard authority.

When active prosecution of a SAR case has been temporarily discontinued pending further developments, the case will be retained in an inactive status and will not be closed until certain that an emergency phase no longer exists or that further efforts would be to no avail. A suspended case file will be maintained and constantly screened so that if additional leads develop the case may be reopened.

CHAPTER IV

RESCUE COORDINATION CENTER

A Rescue Coordination Center (RCC) is a *primary* SAR facility staffed and equipped for coordinating and controlling SAR operations.

ORGANIZATION, EQUIPMENT AND AIDS

RCCs will vary with the physical location and the Regional level on which they are operated but all will have the common element of centralized communication and coordination. RCCs are staffed with RCC Controllers capable of acting as SAR Mission Coordinators.

COMMUNICATIONS

Communications is the backbone of and a mandatory prerequisite for successful SAR operations. RCCs have rapid and reliable communications with all primary and secondary agencies to insure prompt receipt of distress information, to alert assisting agencies, to dispatch SAR facilities and to coordinate and control subsequent SAR operations. Communications should be direct, wherever practicable, to eliminate delays and errors caused by relaying information. Communications normally consist of direct lines (telephone or interphone), commercial telephone and teletype, air to ground, ship to shore, and point to point radio circuits. Rapid and reliable communications are required in all instances of SAR.

LIAISON FILE

RCCs maintain a Liaison File of current data concerning primary and secondary SAR agencies within their areas of responsibility and those of adjacent RCCs. This file includes such information as location of facilities and their communication capabilities, names and position of key personnel, and methods of contacting. Auxiliary facilities are included in this file.

AREA WALL MAP

Each RCC has a large scale area wall map which portrays the RCC's area of responsibility, indicating the location of the following facilities:

A. *Primary SAR Facilities*, which may include specially equipped air and surface craft maintained in constant readiness for full-time duties.

B. *Secondary SAR Facilities*, which may include:
   1. Local military land based aircraft and surface craft.
   2. Other aircraft suitable for SAR missions.
   3. Any military facility.
   4. Coast Guard Auxiliary Facilities.
   5. Merchant ships, private vessels, and civilian aircraft.
   6. Other means available to local authorities.

PLOTTING CHART, EQUIPMENT AND MAPS

RCCs maintain a plotting chart and necessary navigational equipment to plot alert data, bearings, search areas, aircraft assignments, reported leads and sightings. In addition, RCCs have immediate access to, or maintain their own file of, aeronautical and marine charts, road maps, large scale topographical maps and hydrographic publications applicable to assigned area of responsibility.

EQUIPMENT STATUS BOARD

RCCs maintain the current status of all primary SAR facilities under their jurisdiction, and other facilities as deemed necessary.

AIRCRAFT WRECKAGE LOCATOR

RCCs maintain an aircraft wreckage locator file which gives the exact location of known wreckages. Record cards contain type and identification of aircraft, color and distinctive markings, pilot's name, date of crash, location, description of wreckage, and any other pertinent remarks. Photos of each wreckage are attached to the card.

MISSING CRAFT FILE

A record is maintained of all craft reported missing and never located in order to facilitate identification if located at a later date. This record consists of craft type and identification, color and markings, pilot or operator's name, flight or voyage plan, date mission was suspended, and any other pertinent remarks.

OPERATIONS LOG

RCCs maintain an accurate and complete record of their operational activity in an operations log.

PUBLICATIONS LIBRARY

RCCs maintain a publications library of all reference material necessary for performing RCC duties. This library includes:

1. SAR Publications and Directives
2. Flight Information Publications and other Aeronautical Manuals
3. Joint Communications Publications
4. Hydrographic tables—ocean currents, depth, wind, and temperature
5. Nautical and Air Almanacs
6. Airfield survey file

INCIDENT PROCESSING

Incident processing requires the RCC to determine the responsibility, urgency, and extent of rescue service required for reported incidents. Processing procedures are prompt and systematic as speed is of the essence. Incident processing consists of the following:

1. Prompt receipt and recording of all incident data
2. Determining mission responsibility and initial classification of urgency
3. Monitoring the progress of the PRECOM Search or Harbor Check and conducting the EXCOM Search.
4. Evaluating data obtained from communication searches and other sources to identify the incident as false, not requiring rescue service, or requiring that the incident be placed in a more urgent phase.
5. Alerting appropriate agencies, facilities, and personnel.
6. Assigning, delegating or assuming mission control
7. De-alerting all agencies upon termination of the incident.

SAR SUPPORT FOR SPECIAL ACTIVITIES

The National SAR Plan (NSP) does not encompass such activities as salvage operations, submarine rescue, special or unusual operations of the Armed Forces, emergencies affecting public welfare occurring as a result of enemy attack, insurrections, civil disturbances, earthquakes, fire, flood or other public disasters, or equivalent emergencies which endanger life and property or disrupt the usual process of government. However, the National SAR Plan organization and its facilities are utilized to the maximum extent feasible in connection with these activities.

INCIDENT TERMINATION

All interested agencies will be immediately de-alerted when information reveals that SAR services are no longer required. An incident is not "closed" until this action has been completed.

FOREIGN ENTRY CLEARANCE

In the event it is necessary to dispatch SAR forces across foreign borders, the RCC completes necessary actions for required clearances. Designated United States and foreign agencies are notified of all particulars by the most expeditious means available. Aircrews, rescue teams, and other personnel are given a thorough briefing prior to departure on procedures for transiting foreign borders and subsequent operations. Regional SAR Coordinators coordinate with foreign agencies in matters pertaining to SAR operations.

The primary objectives of coordination with foreign states are:

1. To preplan mutual assistance in SAR operations.
2. To facilitate the transiting of international boundaries by SAR facilities.
3. To achieve maximum operational efficiency between U. S. and foreign rescue coordination centers.

AUXILIARY MISSION CONTROL

Coast Guard Auxiliary units (Flotilla or Division) may establish mission control points for coordinating Auxiliary units and Auxiliary operations with an RCC or Coast Guard Group Command. Such a control point is usually at a land radio facility. Equipped with telephone and all of the maps, charts, publications, and liaison file discussed above, the interface of Auxiliary forces with Coast Guard facilities can be effectively managed.

CHAPTER V

SAR FACILITIES

The effecive utilization of all available facilities will insure greater efficiency and economy in SAR operations. The difficulty, very often, is in recognizing those existing organizations, agencies and facilities which may provide the most useful assistance.

COAST GUARD FACILITIES

The Coast Guard is responsible for providing certain primary SAR facilities to discharge its statutory obligations. Included are sea and land planes, amphibians, helicopters, patrol boats of various sizes, crash boats, life boats, motor surf boats, radio stations, SAR teletype circuits, and SAR telephone hotlines. Secondary facilities such as buoy tenders, light ships, ocean station vessels, harbor and ocean-going tugs and ice breakers are available for SAR operations whenever the situation demands. The Auxiliary may provide boats, communication facilities and aircraft under emergency SAR conditions, when directed by the Coast Guard.

OTHER AGENCIES

The Armed Services provide facilities in support of their own operations and fulfill requests of SAR Coordinators for both military and civil SAR missions, operations permitting. Few facilities in commission are assigned specifically for SAR operations. However, the Aerospace Rescue and Recovery Service and associated Pararescue teams are special forces with the primary mission of SAR in support of United States Air Force aircraft.

The Civil Air Patrol (CAP), administered by the USAF, with squadrons throughout the United States, may provide planes, communication facilities, ground rescue parties and miscellaneous specialized vehicles as required for support of SAR operations. Auxiliary flotillas can establish liaison with their local CAP squadron and thereby enhance combined SAR capability.

The Federal Aviation Agency (FAA) provides communication facilities and radio range stations for Information Requests on aircraft and flight plans, and for communication checks on overdue aircraft.

The Federal Communications Commission (FCC) provides long-range Direction Finding (DF) networks.

State, local and harbor police, fire departments, sheriffs' departments and state rescue organizations maintain air and surface craft, specialized vehicles and communication and rescue equipment suitable for SAR operations.

Flying clubs, yacht clubs, scuba diving clubs, and others may have air and surface craft, specialized rescue equipment and personnel useful in SAR operations.

Merchant vessels, fishing fleets, aircraft operating agencies, company planes and helicopters, towing and salvage companies, commercial broadcasting stations, marine radio stations and news media are all potential sources of SAR assistance.

SELECTION OF FACILITIES AND EQUIPMENT

Those who must select, assign, and operate facilities suitable for SAR operations must be familiar with the capabilities, limitations and recommended employment of such equipment in order to intelligently plan and carry out SAR operations. In addition, it is encumbent on all who may engage in SAR operations to be familiar with the various devices used as aids in survivor location and rescue.

THE USE OF AIRCRAFT

The ability of aircraft to reach the location of a distress incident quickly, and to conduct searches over large areas rapidly, makes them an effective means of locating survivors. They are capable of making air drops of survival gear, flying cover for other units, providing Communications relay, and, in the case of amphibious aircraft, effecting water landings under some conditions.

SEAPLANES AND AMPHIBIANS

Seaplanes and amphibious type aircraft may be employed to search for and orbit survivors, to drop emergency gear, to direct or home surface craft to the scene, and, if conditions warrant, to effect rescue.

LANDPLANES

Landplanes are generally capable of performing the same functions as seaplanes except for water operations.

When climatic conditions permit, land-based aircraft may effect rescue by using frozen lakes and rivers as runways. If equipped with skis, aircraft are also able to land and take off on snow. These operations are normally hazardous, and the urgency of the situation should be considered carefully before they are attempted.

HELICOPTERS

Helicopters represent one of the finest facilities for rescue operations, particularly in inaccessible locations and for searches where their slow speed and hovering capabilities can be utilized. They can land and take off from extremely confined areas, can operate from water when fitted with floats and are able to effect rescue from a hovering position when fitted with hoisting gear. When based on ships at sea, helicopters have proved particularly valuable in rescuing personnel involved in flight accidents, ditchings and man-overboard missions, as well as in conducting close searches for missing aircraft and personnel. Helicopters have certain limitations as to range, altitude, instrument and night flying, and navigational and communication capabilities, which must be thoroughly understood by SAR Mission Coordinators, RCC Controllers and On-Scene-Commanders. They are also adversely affected by high winds.

THE USE OF SURFACE CRAFT

Surface craft of all types are inherently suitable for SAR incidents on water. The use of a particular type vessel will be dependent upon the location of the incident, the size and type of unit in distress, weather conditions, and the speed, range and sea-keeping qualities of the vessel.

Surface craft may be used singly or in groups to conduct searches and to effect rescues. However, an effective arrangement is to search with aircraft and effect rescue with surface craft. In many instances the search may be jointly conducted with the vessel acting as plane guard and plane controller. The latter method of searching is particularly effective in providing a high detection probability when the search target is small and its position is known to be within a limited area.

For SAR purposes, vessels may be categorized as follows:

1. Rescue Boats–Small craft used for local, close-in and short-range SAR operations. This category includes small pleasure boats, lifeboat station craft, Coast Guard patrol craft (82 feet to 95 feet) and rescue and crash boats. Auxiliary facilities belong in this category.
2. Rescue Vessels–Long range vessels of reasonable speed with good sea-keeping qualities and adequate communication equipment. Vessels in this category are rescue tugs, merchant vessels, Navy vessels of many types with emphasis on destroyers and destroyer escorts and various types of Coast Guard vessels, particularly high endurance cutters (HEC) (255 feet to 378 feet), and medium endurance cutters (MEC) (143 feet to 213 feet).

FISHING VESSELS, YACHTS, AND SMALL PRIVATE CRAFT

Fishing vessels, yachts and other small private craft (including vessels of the Coast Guard Auxiliary) provide another potent source from which SAR assistance may be obtained. Many vessels of this type are equipped with radiotelephone, which considerably enhances their value. The Coast Guard frequently receives original reports of distress from craft of this nature, and oftentimes has them stand by other craft in distress until more effective assistance can be provided. Vessels of this type frequently aid one another by recovering survivors and providing towing or other services.

Coast Guard Auxiliary operations officers should seek a balanced array of flotilla and divisional facilities. Large, deep draft, powerful vessels; small, fast, shallow draft utility craft; airboats; sea and land aircraft; radio shore stations; land mobile units and portable communications gear are all part of a complete capability for SAR.

CHAPTER VI

SEARCH AND RESCUE PLANNING

The technical search planning discussion in this chapter is only of general informational interest to Auxiliarists. In practice these detailed functions are the responsibility of, and would normally be performed by, the RCC or other Coast Guard unit.

GENERAL CONSIDERATIONS

Planning for a search involves:

1. The most probable position of a distress incident or its survivors, corrected for drift. This is called the *Datum*.
2. The determination of the search area.
3. The determination of the *desired* area coverage.
4. Determination of the *attainable* area coverage.
5. The selection of search *patterns*.

This chapter is concerned with the first two stages of search planning. Regardless of the perfection of search patterns to be employed, *all is for naught unless the search is made in the area in which the distressed craft or survivors are actually located*.

This most probable position of a distress incident may be determined by a fix, or position reported at the time of the incident, or by dead reckoning estimate from the last known or reported position of the craft in distress.

Determination of the extent of the search area is based on the accuracy with which the most probable position of the incident or survivors is known, taking into account such factors as errors in position, drift, navigation errors of search craft, and weather conditions.

Selection of search patterns depends on the availability, number and types of craft suitable for the mission, as well as the weather conditions in the area to be searched.

When information vital to determining the most probable position of the incident or survivors is not available, search planning becomes a more difficult matter. Because it may be impractical and time-consuming to search the entire area in which the incident may have occurred, or in which survivors may be located, the SAR Mission Coordinator must reconstruct the incident with whatever information is available. The search area, in such cases, is usually based on the presumption that the craft met with an accident or became lost on its intended course. The initial phase of search is confined primarily to the intended course and its immediate surrounding area. If no results are obtained, the SAR Mission Coordinator (or OSC, as applicable) must either extend this search area or determine other areas to be searched.

DATUM (Probable Position Corrected for Drift)

First, the most probable location of the incident or survivors must be determined. The most probable location is obtained in one of two ways: (1) from reports based on a navigational fix, electronic aids, or dead reckoning or (2) from knowledge of course intended by distressed craft as reported by observers, friends or relatives of the operator.

This most probable location must then be corrected for drift and is called the *Datum*. It then must be constantly updated during a search. Drift consists of the movement of a floating object due to currents (movement of water past a geographical object) and LEEWAY (movement of a craft through the water due to wind acting on the craft).

There are two types of currents: sea or tidal current and wind-driven current. Sea current magnitude can be obtained from the U.S. Navy Oceanographic Publication for the oceans and from National Ocean Survey Tidal Current Tables for tidal regions; from local current charts for lakes and rivers or from local knowledge, if no other data is available. An estimate of wind driven current in the open sea can be obtained by use of Figures 8 and 9 in the Appendix, using wind velocity and direction during the past 48 hours. The assumptions on which the figures are based are only valid in the open sea, where land masses do not interfere with the action of the wind on the water, or on the currents generated by them.

Leeway magnitude can be obtained from Figure 10 in the Appendix. A liferaft's leeway is downwind whereas boats may drift as much as 40° off the wind direction.

The total drift is then determined by adding, vectorially on a maneuvering board, the magnitude and direction of sea current, wind-driven current and leeway.

TOTAL DRIFT = SEA (OR TIDAL) CURRENT
+ WIND DRIVEN CURRENT
+ LEEWAY

The most probable location at any given time is that originally obtained corrected for the total drift over that given time period. Thus a DATUM is determined.

Next after determining the most probable position of occurrence of the distress, and the probable position of survivors by applying drift to determine movement since the incident, an analysis must be made to determine how much the computations are probably in error. This value, the Total Probable Error of Position, is one of the most important values one must calculate, for upon it will depend the extent of areas to be covered. The greater the error, the larger the area that must be searched. The variables which make up the Total Probable Error of Position, denoted by (c) are:

Initial Error of Position of Incident (X).
Navigational Error of Search Craft (Y).
Drift Error (de).

The Total Probable Error of Position is determined by the formula:

$$c = \sqrt{d_e^2 + X^2 + Y^2}$$

There is no easy way to accurately determine these values, and each case must be evaluated on its own merits. A careful examination of the factors involved in each variable will, however, afford the planner a basis for his estimate.

Initial Error in the Position of a Distress Incident (X)

When the reported position of a distress incident is based on an accurate navigation fix, or on a fix determined by a DF or Radar, the error of a small craft fix may be assumed to be a 15 mile radius. When the planner knows that the navigational capability is better than this assumption, he should use the best estimate.

When the reported position is based on dead reckoning (DR), assume the following error for small craft—15% of distance since last fix, plus error of that fix.

Navigational Error of Search Craft (Y)

The navigational error of search craft will depend on the method the search craft will use for determining its location when arriving at datum. In computing the navigational error of search craft, use the same rules as used to determine the Initial Error in the Position of the Distress Incident.

Drift Error (d_e)

The error in estimating survivors drift is generally assumed to be the total drift divided by 8. This method of computing drift error is used only when an average drift has been computed. When minimum and maximum drifts are computed, the drift error (d_e) is determined simply by entering Figure 2 with the values of maximum drift distance (D_{max}) and minimum drift distance (D_{min}) and picking out the drift error (d_e). The values are listed to the nearest mile. While this procedure is slightly more complicated than estimating a mean drift and dividing by 8, it is more accurate and far more dependable when input values are uncertain.

Total Probable Error of Position (c)

This value combines the probable error of the initial position of the incident, navigational error of the search craft, and drift error. Total Probable Error of Position is found by the formula:

$$c = \sqrt{d_e^2 + X^2 + Y^2}$$

Where:

c = Total Probable Error of Position
de = Drift error
X = Initial Error of Position of Incident
Y = Navigational Error of Search Craft

Example:

With X = 10, Y = 8 and d_e = 21.2

$$c = \sqrt{(21.2)^2 + (10)^2 + (8)^2} =$$

$$\sqrt{450 + 100 + 64} = 24.8 \text{ miles}$$

Once a datum point has been determined *it should be marked with a buoy*. The buoy will then act as a drifting datum point and navigation aid for search aircraft. While it may be argued that a leeway difference may exist, such difference will probably be small and much less than would be incurred with the use of computations alone for drift determinations. Visual markers may be used such as smoke floats or dye markers, but datum must be re-marked before the original dissipates and successive re-markings must be made.

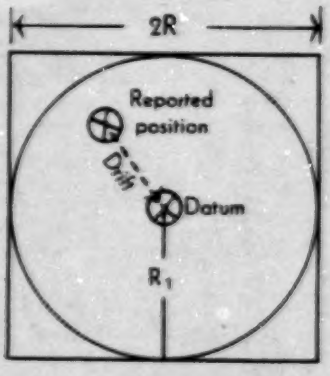
DETERMINATION OF SEARCH AREAS

After determining the probable initial distress position, drift, datum point and total probable error of position, the planner is ready to consider the radius of search.

Search radius, expressed in nautical miles, is a measure of distance used in determining the search area. It is defined as a radius of a circle originating at the most probable position of the target at any specific time (datum point) and having a length equal to the total probable error of position, plus a safety factor to ensure complete coverage. The radius is extended with each successive search. The relationship between Total Probable Error of Position (c) and Search Radius (with a safety factor or overlap incorporated) is:

SEARCH	SEARCH RADIUS
1	1.1c
2	1.6c
3	2.0c
4	2.3c
5	2.5c

The radius for each search will thus be larger than for the preceding search until a radius 2.5 times the total probable error of position is reached on the fifth search. If any considerable time interval occurs between searches, the total probable error of position will have to be recomputed before each search to take into account the increased drift error that has occurred between searches.



INITIAL SEARCH AREA WHEN POSITION IS KNOWN

MINIMUM DRIFT DISTANCE

MAXIMUM DRIFT DISTANCE	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150
10	1														
20	7	3													
30	12	8	4												
40	18	14	9	5											
50	24	19	15	11	6										
60	29	25	21	16	12	7									
70	35	31	26	22	17	13	9								
80	40	36	32	27	23	19	14	10							
90	46	42	37	33	29	24	20	16	11						
100	52	47	43	39	34	30	26	21	17	13					
110	57	53	49	44	40	36	31	27	22	18	14				
120	63	59	54	50	46	41	37	32	28	24	19	15			
130	69	64	60	56	51	47	42	38	34	29	25	21	16		
140	74	70	66	61	57	52	48	44	39	35	31	26	22	17	
150	80	75	71	67	62	58	54	49	43	41	36	32	27	23	19

DRIFT ERROR AS A FUNCTION OF MAXIMUM AND MINIMUM DRIFT DISTANCES

Figure 2

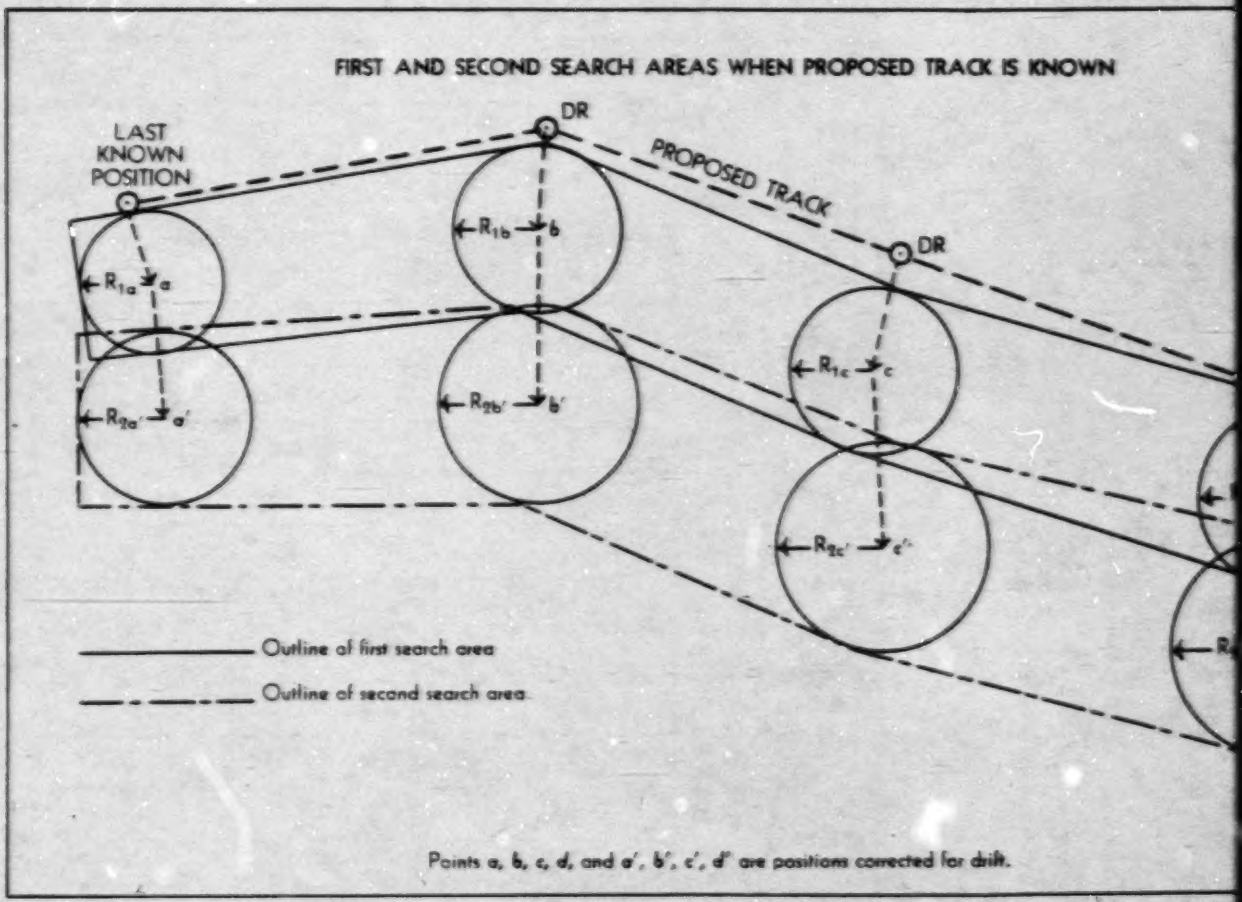

FIRST AND SECOND SEARCH AREAS WHEN PROPOSED TRACK IS KNOWN
LAST KNOWN POSITION
DR
PROPOSED TRACK
DR
R_{1a}
a
R_{1b}
b
R_{1c}
c
$R_{2a'}$
a'
$R_{2b'}$
b'
$R_{2c'}$
c'
Outline of first search area
Outline of second search area
Points a, b, c, d, and a', b', c', d' are positions corrected for drift.

Figure 1

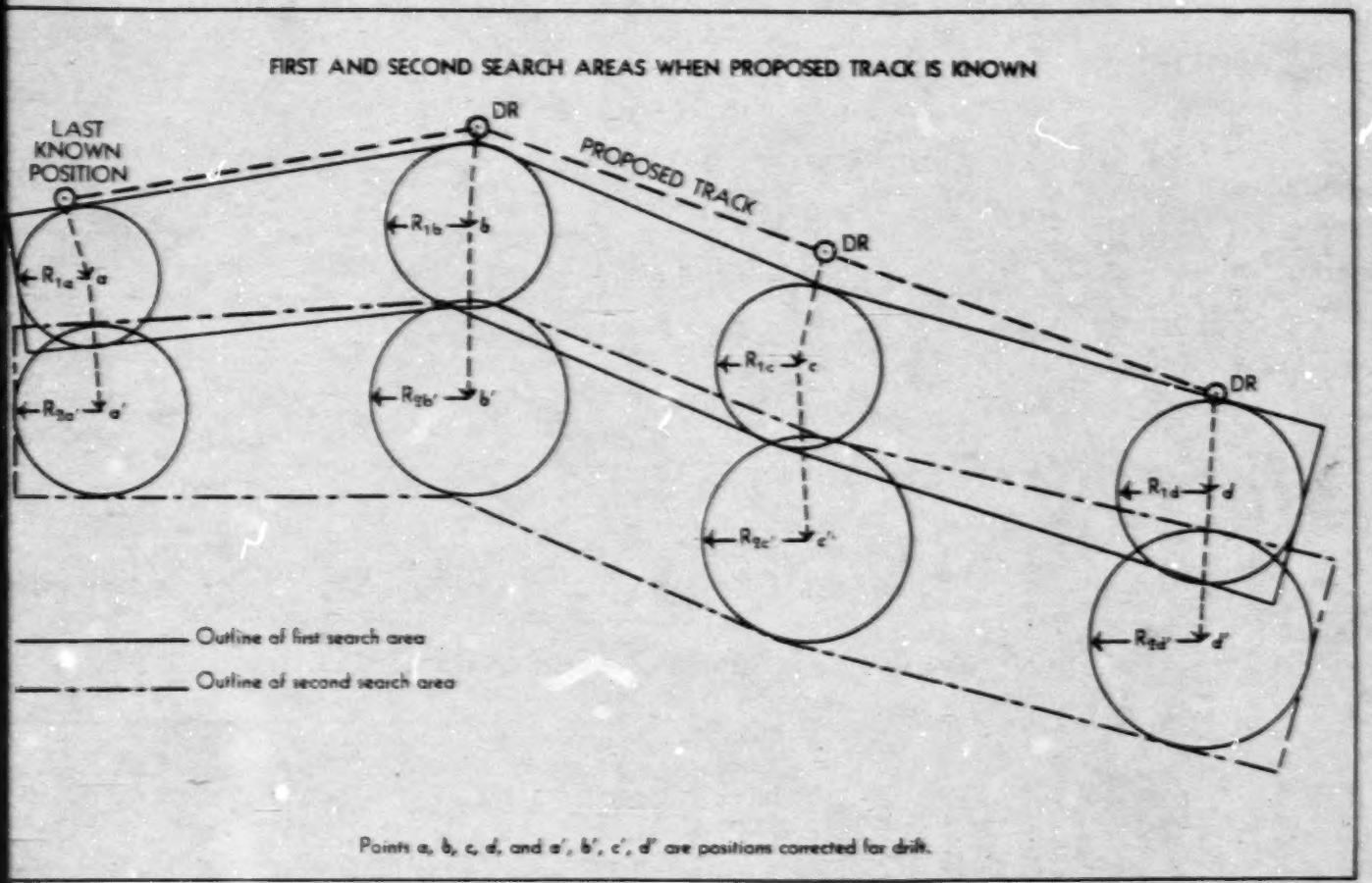

FIRST AND SECOND SEARCH AREAS WHEN PROPOSED TRACK IS KNOWN
LAST KNOWN POSITION
DR
PROPOSED TRACK
DR
DR
R_{1a}
a
R_{1b}
b
R_{1c}
c
R_{1d}
d
$R_{2a'}$
a'
$R_{2b'}$
b'
$R_{2c'}$
c'
$R_{2d'}$
d'
Outline of first search area
Outline of second search area
Points a, b, c, d, and a', b', c', d' are positions corrected for drift.

Figure 1

When the position can be fixed or estimated, the best theoretical search area is a circular area centered on the datum point. The size of the circle is determined by the search radius. The circular area is squared off except in the special case where Sector Search Patterns are going to be used. In view of the uncertainties in estimating the Total Probable Error of Position, it is essential that the search radius be expanded far enough to insure inclusion of the target in the search area.

When no clue to the position of a distress or of survivors exists, the planner must determine search areas based on the best available information.

a. *When the Proposed Track is Known.*

If a flight plan has been filed or a surface craft's routing is known, search areas will normally be based on the projected track from the last known position. It is necessary to use two or more DR positions along the track from which to determine a series of probable positions (datum points). These are found by correcting each DR position for drift. For each corrected position a Total Probable Error of Position is then determined as previously described and first Search Radii are found. After drawing the circular areas using these radii, tangents from circle to circle will outline the lateral limits of the first search area. The ends of the area thus defined can then be squared off.

b. *When the Proposed Track is not Known.*

When not even a proposed track is known, the search planner may have to depart from the rules given previously and outline the search area based on other hypotheses. For instance, a military aircraft may be reported missing while flying in a defined *operating area*; a fishing vessel may have gone to particular *fishing grounds*; a private aircraft or pleasure boat may be known to have intended operating in a *general area*; a yacht may have been on an extended coastal or ocean cruise. In some cases the search area will be readily apparent. In others, the area can be narrowed by communications checks and deduction. In still others, the planner can only plan to search large general areas as best he can.

SEARCH PATTERNS

Thus far this chapter has dealt with what areas to search. Once the area is determined, density of search and track spacing can then be determined. Many different patterns may be used to search the area. However, certain patterns will prove more advantageous than others in particular situations. The advantages and disadvantages are shown in Chapter 7.

CHAPTER VII

SEARCH AREA COVERAGE

GENERAL CONSIDERATIONS

Determination of area coverage involves many factors which influence detection capability during a search mission, and these factors are seldom identical in any two situations. The relative influence of these factors can be predicted within limits, and the awareness of them will aid in search planning and will increase the effectiveness of search. The factors affecting detection capability can be reduced to four interrelated mathematical expressions and these can serve to simplify the employment of search units. The terms for these mathematical expressions, together with their symbols are:

Probability of Detection (P)
Sweep Width (W)
Track Spacing (S)
Coverage Factor (C) = $\left(\frac{W}{S}\right)$

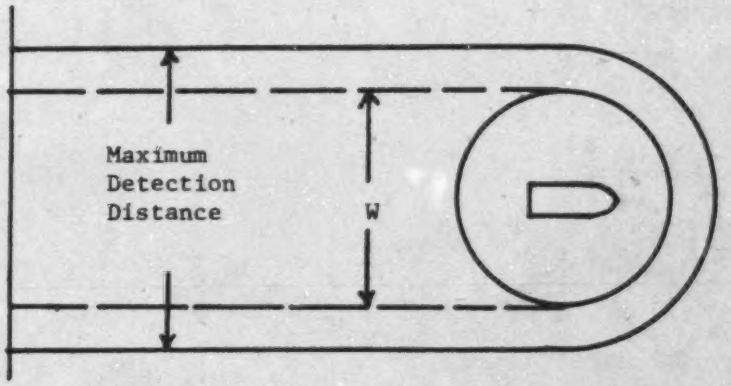
Their derivation, interrelationships, and applications are explained in the sections that follow. The accuracy of any mathematical solution depends on the accuracy of input values used with the formula. Unfortunately, many factors may at times combine to make the sweep width (W) and the track spacing (S) subject to large errors. This chapter will consider those factors affecting sweep width together with a practical approach to determining as accurate a value of sweep width as possible, and some means to obtain the maximum sweep width under any given set of conditions. Track spacing is affected by the type of search pattern, navigation, and the manner of execution of the search. Poor planning and/or execution may cause such inaccurate track spacing as to seriously impair the usefulness of the search.

PROBABILITY OF DETECTION (P)

A definite probability of detection exists for each scan made by the search unit's lookouts or detection equipment. The probability that a contact will be made in a single scan is called the *instantaneous probability of detection*. This instantaneous probability of detection, repeated with successive scans as the search unit moves along the track, develops the probability pattern of a given search. The probability of detection is not uniform across the swept area. It is highest at short distances from the search unit, and decreases as the distance from the search unit increases. In order to overcome this lack of uniformity, we use the concept of sweep width which reduces the detection capability for a given sweep to a single numerical value.

SWEEP WIDTH (W)

Sweep Width is a mathematically expressed measure of detection capability in which the maximum detection



Sweep Width

distance of any given sweep is reduced in such a way that scattered targets which may be detected beyond the limits of W are equal in number to those which may be missed within these limits. The application of this sweep width concept permits a simple solution of search problems that would otherwise be practically unworkable. Tables of values for W are given in the Appendix. These values are for moderate wind conditions, and it must be strongly emphasized that they may be in error under more adverse wind conditions or conditions of poor lighting. *The wind (whitecap) factor should be applied to the basic sweep width value.* Correction factors for no-wind conditions are less than one due to impediments to sighting because of reflections from glassy water.

The question may arise as to which value of sweep width to use. A pilot in a raft may have several pyrotechnic devices, each having a different sweep width, and each greater than that of the raft. As these may be lost overboard or not be used, it is best to be conservative and *select the minimum value of a sweep width shown for the raft alone.* An exception to this rule will be found in night search. In this particular case, only pyrotechnics or lights can be seen, and night searches are based on this assumption. It must be remembered in this case that sweep width is dependent on the range at which the survivor can see the rescue craft's navigation lights or hear its engines, for liferaft pyrotechnics are not ordinarily used until a rescue craft is sighted or heard. A night search is always indicated when survivors may have pyrotechnics. In very high winds and seas, lights or pyrotechnic signals can be seen far better at night than can visual signals in daylight.

FACTORS AFFECTING SWEEP WIDTH

The range at which a given target will be detected depends on several factors, and the complex relationship between these factors makes it impossible to assume that a certain type target will always be detected at a given range. The factors affecting sweep width are listed below in approximate order of influence:

a. *Type of Target*

The sweep width will depend on the size and shape of the target, its color contrast with the surrounding medium, amount of freeboard, and whether or not the target is moving. Very small targets, such as liferafts, are very difficult to see. A man in the open sea without some type of visual aid is an almost hopeless target. Very large targets, on the other hand, can often be seen to the limit of meteorological visibility.

Color aids detection due to its contrast with the surrounding or background colors. A small target that contrasts in color with the background can often be seen easier than a much larger target that blends with the surrounding medium. However, very small targets can only be seen a limited distance regardless of color contrast. For the color to be effective, the eye must look directly at the target. The color receptors of the eye are concentrated in the center of the retina, and objects that would be seen out of the corner of the eye are unlikely to be seen due to color contrast alone. Yellow, red or orange colors provide good contrast against a water background. However, yellow and white objects are not seen easily when whitecaps exist. Under such conditions, red appears to be the optimum color.

The amount of freeboard influences detection. A large target with little freeboard may not be seen by a surface unit or a low flying aircraft, or may not be seen up-sun under conditions where a smaller target with high freeboard would be detected. Objects with high freeboard, also, are generally more susceptible to detection by radar.

Whether or not a target is moving is also a factor, due to the disturbance in the water created by such movement. The faster a vessel moves, the greater is the wake, and consequently, the detection range. In over water searching, it is quite common to sight the wake of a fast moving vessel long before the vessel itself is sighted. Any movement by an object in light seas is likely to attract attention; for example, a whale breaking the surface, or seas breaking over a partially submerged derelict.

b. *Meteorological Visibility*

Meteorological visibility is the maximum range at which very large objects such as land masses or mountains can be seen. Reduced meteorological visibility will result in reduced sweep width for any particular object. The detection range of all except the very largest objects (such as mountains) will always be less than the meteorological visibility. The obscuration to visibility causing the reduced meteorological visibility will reduce the ability to detect objects well inside the meteorological visibility range. Meteorological visibility as observed from the cockpit of a search aircraft may be considerably less than that observed from a surface point because of windshield obscuration, altitude, and other factors. Conversely, with shallow surface fog, objects on the surface can often be detected by aircraft when they cannot be seen by vessels.

c. *Sea Condition*

The existing sea condition is an important factor, and under some conditions becomes the paramount one affecting sweep width. It is not necessarily the height of the sea or the existing swell systems, but the amount of whitecaps and breaking seas that prove detrimental. On a

glassy sea any object, or disturbance, will probably attract the attention of the eye. On a glassy or smooth sea accompanied by a swell system, chance of detection is also good, being lessened primarily by the intervals in which the object may be hidden from the lookouts of a low flying search aircraft or the lookouts of the ship.

The presence of whitecaps and foam streaks on the water break the uniformity of the surface and markedly reduce lookout effectiveness. As the whitecaps become more numerous, the probability of detecting a small object becomes less. With numerous whitecaps and foam streaks in a heavy, breaking sea, even very large objects are very difficult to detect, and small objects are unlikely to be detected at all. With high winds which accompany rough seas, visual aids are rendered less effective. Dye markers tend to dissipate rapidly and smoke signals cling close to the surface and cannot be differentiated from the foam streaks. The reflection of the sun off the breaking seas and whitecaps tends to dull the perception of the lookouts to visual signals. With high winds, the wind-driven salt spray constitutes a very real visual obscuration.

Rough seas also adversely affect radar detection due to the large amount of sea return on the scope, and the fact that small targets in the trough of a sea cannot be detected.

d. *Altitude*

It is impossible to prescribe an optimum aircraft research altitude for all conditions. Under average conditions, medium size liferafts are best detected at altitudes of between 800 and 1500 feet, swimmers between 400 and 500 feet. In case of reduced visibility these altitudes should be decreased. If uncertain of whether or not survivors are in rafts, search should be at an altitude that will allow detection of swimmers. Search for large vessels is conducted at higher altitudes, though 5000 feet is seldom exceeded. Flying at very low altitudes has certain disadvantages, such as the rapidity with which an object passes the field of vision, the more acute angle presented by a low freeboard object, and the tendency of the pilots to concentrate more on their instruments and flying than they would with some altitude for a safety margin. Also to be considered when selecting an altitude for search are the amount and height of clouds, turbulence at various levels, and effect of altitude on horizontal visibility. The problem of identification must also be considered. For example, if the target is a trawler, and a large number are present in the search area, a low altitude will probably be preferable to prevent having to descend to identify each one sighted. The sea condition will also have an effect on the altitude chosen, as will the type of radar being used.

For night search, an altitude of 1500 - 2000 feet is considered suitable, as the primary objects of search are pyrotechnics and lights. The following table summarizes the recommended altitudes:

	Over Water
Below 500′	Survivor without raft or dye marker.
800′ - 1500′	Survivor in raft without dye marker or signaling equipment.
1000′ - 2000′	If survivors have dye marker.
1000′ - 3000′	If survivors have signaling equipment and/or radar deflector.
1500′ - 2000′	During night search over water.
	Over Land
1000′	Survivors of an aircraft incident over level terrain with little or no foliage.
500′	Survivors of an aircraft incident over level terrain with heavy foliage.
500′ - 1000′	Survivors of an aircraft incident in mountainous terrain (altitude will be selected based on turbulence and foliage coverage).
2000′	Overland at night.

e. *Position of the Sun*

Objects will be seen furthest down-sun, and will be most difficult to see up-sun when the sun is in a position to cause reflection on the water. With clear sky and a bright sun, search conditions will be at an optimum between mid-morning and mid-afternoon, while the sun is high. Searching into the direct path or glare of the sun is ineffective without suitable dark goggles. Sunlight reflected from the water tends to blot out a smaller dark area such as would be formed by a raft. Objects with high freeboard can sometimes be seen even in the sun's glare. Bright sunlight is especially detrimental if haze is present, due to the diffusion of light. Color contrast is lost when looking up-sun, with the result that small objects are lost in a confused pattern of glaring light and shadow. Down-sun, the sea is much darker, there is no glare, the haze is more transparent, and colored objects show a marked contrast to their background. Lookouts forced to look into the sun suffer loss of visual acuity and may easily fail to detect an object. When possible, the search legs should be oriented to avoid having to look directly into the sun. If this is not possible, lookouts should be equipped with suitable dark polaroid goggles.

f. *Effectiveness of Lookouts*

The effectiveness of lookouts depends on the number of lookouts, their state of training, alertness,

physical condition, incentive, dark adaptation at night, and on the suitability of positions. The speed with which the search unit is moving has a direct relationship to the effectiveness of lookouts. The slower the speed, the more effective is the scanning. In rescue operations the majority of contacts have been made by visual sightings rather than by electronic means. While electronic detection equipment is invaluable when operated properly, emphasis must be placed on visual detection methods.

g. *Night and Day Factors*

Under some conditions of wind and sea, daytime visual aids are relatively ineffective. The signal mirror is an exception, but sunlight cannot always be expected. Sea conditions and wind have little effect on the night flare type pyrotechnics or on lights. Even a flashlight has a chance of being seen. With high winds and seas, night search often offers the best probability of detection. Unfortunately the pyrotechnics supply available to survivors is usually limited, and survivors are unlikely to fire pyrotechnic signals until after the lights of the search unit are sighted. *For this reason sweep width should be based, not on the expected sighting range of the pyrotechnic aids, but on the range at which the navigation lights of the search unit can be sighted by survivors*. Search units on entering a search area should turn on all possible lights, and from time to time display search lights or landing lights to facilitate sighting of the search unit by survivors. Ships in the search area during daylight should make smoke at intervals.

h. *Obscurations to Visibility*

The primary obscurations to vision are rain, snow and fog. Rain, even with the best windshield wipers on aircraft, seriously reduces search effectiveness. Snow is often more detrimental than rain. Both, if heavy enough, may make it nearly impossible to sight an object even close aboard. Fog and low ceilings reduce meteorological visibility, though they do not affect windshields as do snow and rain. Pilots flying under conditions of low visibility invariably concentrate on their instruments and inside cockpits. If conditions are severe, sweep width and probability are so reduced that search by aircraft may be useless. To attempt visual search under such conditions may be hazardous to aircraft, especially if separation under instrument conditions is not provided.

i. *Miscellaneous Factors*

Among the miscellaneous factors affecting sighting are shadows cast by clouds, rain showers, large patches of seaweed and pure chance.

Shadows cast by scattered and broken clouds are a distracting influence on the lookouts. Rain showers can result in areas not being searched effectively, as the object of search may be hidden in the squall. In spite of all other factors, some sightings are made as a result of pure chance. A lookout will look at the right spot at the right time and a sighting will be made. On the other hand, a momentary lapse on the part of the lookout may allow the object of search to be passed unseen. The only safeguards against this are repeated search of an area if search units are available, and use of the maximum number of lookouts.

TRACK SPACING (S)

Track spacing, denoted by S, is the distance between adjacent search tracks. These tracks may be produced by the simultaneous sweeps of several units or by the successive sweeps of a single unit. The probability of detection is increased by decreasing the track spacing. If S is decreased, the probability of detection is increased at the expense of decreasing the overall area searched in a given time. There is also a limit to which S can be reduced, due to the limits of accuracy of navigation by search units. The optimum track spacing is that which permits the maximum expectation of target detection in the available time, or that is consistent with economic employment of the search units.

COVERAGE FACTOR (C)

The quality of coverage for any sweep depends on the relation between the sweep width and the track spacing. For convenience in the solution of search problems, this relationship is termed coverage factor, denoted by C, and expressed by the equation:

$$\text{Coverage Factor} = \frac{\text{Sweep Width}}{\text{Track Spacing}} \text{ or } C = \frac{W}{S}$$

Track spacing and sweep width control the probability of detection. This is shown by the probability graph in the Appendix. With the coverage factor known, the corresponding probability (P) can be determined from the graph. Increasing the value to 1.0 results in a worthwhile gain in probability. With higher values, the slight additional gain in probability is not commensurate with the greatly increased effort.

TIME

The time within which the search must be completed may be governed by estimated survival time, approaching storms, etc. Shortening this time allowance can only be accomplished by added search effort, or reduction of coverage factor, or reduction of area, or a combination of these steps.

SURFACE CRAFT DISTRESS

A surface craft distress may involve a vessel still afloat but in need of assistance. In such a case, the detection probability is excellent. Large vessels are good visual and radar targets, and often are able to give an accurate fix by radio. A disabled vessel hove to is more difficult to detect visually than one underway but radar detection is unaffected. Small surface vessels may prove difficult to detect by either visual or electronic means. The probability of visual detection of even a large vessel in heavy seas is greatly overestimated by most searchers. In many cases, large vessels are not detected until the search unit is close aboard. Small craft and fishing vessels are even more difficult to detect under such conditions, and search aircraft in many instances have flown directly overhead without making contact. If the disabled vessel is in heavy seas and has lights and power, the probability of detection is better at night. In searching for a distressed vessel still afloat, radar detection capabilities are usually such that search can be carried on under reduced visibility conditions. A problem may arise in identifying targets, especially when surface traffic is heavy.

If a distressed vessel has foundered prior to arrival of rescue units, the most probable objects of search will be lifeboats, rafts, debris, oil, and personnel in the water. Lifeboats may vary in size from 12 feet to 50 feet in length and be of any color. White is the most common color, (however, many are now painted International Orange). Rafts may be doughnut, pneumatic, or box types and of any color. As a general rule, the doughnut and box types are the same color as the vessel. The scene of the disaster is usually marked with a considerable amount of debris when a large vessel goes down. Often a large oil slick is present. The debris will be found downwind of the origin of the oil slick, and boats and rafts will usually be downwind of the debris. Persons in the water are usually found in the area of the debris clinging to floating objects. If the vessel was abandoned some time before sinking, lifeboats, rafts and personnel may sometimes be found upwind of the point of foundering. Because of this, search units should search both upwind and downwind of the oil and debris area.

Small craft such as yachts and fishing vessels usually carry only a small dinghy; some have only a small balsa or pneumatic raft, and others have only lifejackets. Dinghies may be of any color, but are usually white or mahogany.

Lifeboats from large vessels are normally equipped with ample pyrotechnic and visual aids and many carry an emergency radio. Many also have power and/or sail. If more than one boat is launched, they can be expected to be grouped or tied together if possible, making sighting easier. Boats or rafts from small craft usually have a very limited supply of visual detection aids, and in many cases have none.

AIRCRAFT DISTRESS

With the possible exception of seaplanes, aircraft usually sink rapidly after going down at sea. The only objects usually found on the water will be pneumatic rafts, and bits of debris which are usually too small to be seen from the air. If the aircraft has crashed rather than make a controlled ditching, there may be nothing other than a possible oil slick. Large aircraft flying the ocean have an adequate supply of life rafts, visual aids, and emergency portable radios. The rafts in large transport aircraft are for the most part the large 20-man type. In military aircraft, the 7-man type is still in widespread use as well as the 20-man type. Single engine military aircraft will usually be equipped with a one-man life raft. Small civilian aircraft seldom carry rafts, and any survivors from a ditching of one of these will generally be found in the water.

CHAPTER VIII

SEARCH PATTERNS

GENERAL

The greatest amount of time and effort in every SAR is placed in the *search operation* rather than on the rescue. Coast Guard personnel spend many hours each year looking for overdue, lost or missing boats and aircraft. Experience has shown that a systematic plan for the search operation is necessary to save time and energy and speedily locate the object sought. The object sought is referred to in search as the target.

BASIC SEARCH PATTERNS

1. The five Basic Search Patterns used in the Coast Guard are:

   a. Track Crawl Pattern (T)
   b. Parallel Track Pattern (P)
   c. Creeping Line Pattern (C)
   d. Square Pattern (S)
   e. Sector Pattern (V)

2. These five basic patterns each have variations. The primary use and sketch of each of these five patterns will be discussed independently.

SEARCH AREA DESIGNATION METHODS

The search area may be designated by any of the following methods listed in order of precedence:

1. *Center Point Method*

   Any rectangular or square area can be designated by giving the geographical coordinates of the center of the area, the direction and length of the longer (major) axis, the length of the minor axis, and the direction of creep. Creep is a term used to indicate the direction in which the search is to move. For example, if a unit is to execute a creeping line search, using north and south legs, the "creep" may be either east or west, depending upon which end of the area the search is started. If the controlling activity desired the search to start on the east end of the track and advance toward the west, the search unit would be instructed to "creep" 270°.

   EXAMPLE:

   "Search Pattern Charlie Sierra. Center point 34-17 North 116-22 West; Axis 025 True, 80 x 40, Creep 205 true."

2. *Boundary Latitude and Longitude Method*

   This method is used when the search area is oriented either north-south or east-west. All that need be given are the northern, southern, eastern and western boundaries.

   EXAMPLE:

   "Search Pattern Charlie Sierra. 28-00N to 27-50N, 79-00N to 70-10W."

3. *Geographical Coordinates*

   The corners of the area defined by geographical coordinates of latitude and longitude. This method has the disadvantage of being somewhat lengthy and subject to communications transmission error.

   EXAMPLE:

   "Search Pattern Papa Sierra."
   "23-15N 74-25W to 23-10N 73-25W to 22-20N 73-25W to 22-25N 74-25W to origin."

4. *Track Line Method*

   In a track line search, the points on the track are given to define the track, and width of coverage prescribed, if a certain width is desired.

   EXAMPLE:

   "Search Pattern Tango Sierra Romeo. 24-06N 78-55W to 24-50N 75-46W. Width 50 miles."

5. *Grid Method*

   Many areas are divided into grids by local grid charts. These may be used only when such charts are available to all search participants.

6. *Landmark Method*

In searching well marked areas, such as rivers, bays and lakes, reference may be made to a charted landmark or navigational aid to assist the search unit in locating the proper area.

EXAMPLE:

"Search Pattern Papa Sierra. Area bounded north by Chesapeake Bay Bridge, South by Bloody Point Light Width 10 miles. Creep West."

SEARCH AREA

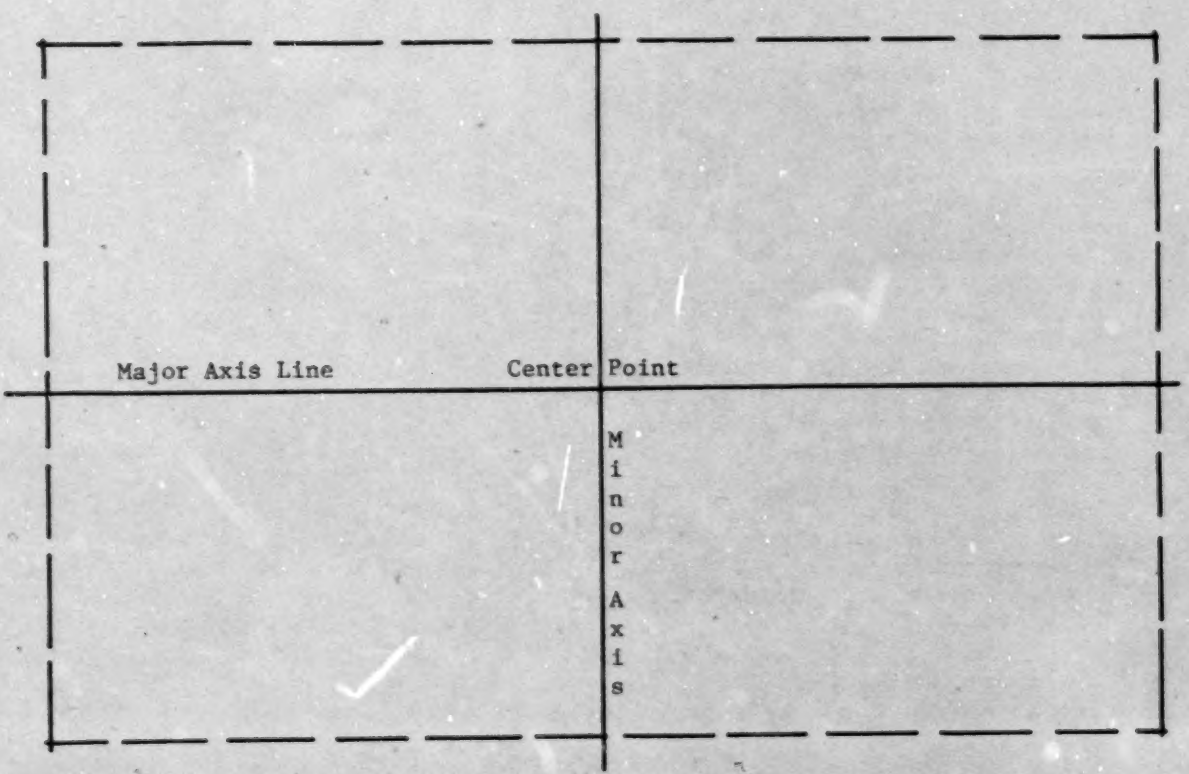
In order to designate an area to be searched, the area should be considered rectangular in shape as indicated by the broken lines below. An exception is when a sector search pattern is to be used, in which case a circular area is designated. Through the center of the longer axis is an imaginary line known as the Major Axis and one through the shorter axis known as the Minor Axis as indicated by the solid lines in the example. The point at which these lines cross is called the center point.

TRACK CRAWL PATTERN (T)

1. *Purpose*

The track crawl search is the one most likely to be used during the alert phase when an aircraft or vessel has disappeared without a trace. It consists of a rapid and reasonably thorough coverage of the intended course of the missing craft. This is based on the assumption that the missing craft is on or near the track, or that there are survivors who may be able to asssit by displaying signals. For this reason it is often known as the *primary search pattern*, the secondary or intensive phase, being introduced on failure of the track crawl. Provided that conditions are suitable, this search may be employed at night. It requires a minimum of search planning.

2. *Symbol designations are:*
   a. Single unit return-Tango Sierra Romeo (TSR)
   b. Multi unit return Tango Mike Romeo (TMR)



c. Single unit non return Tango Sierra November (TSN)
d. Multi unit non return Tango Mike November (TMN)

3. *Pattern Operation*

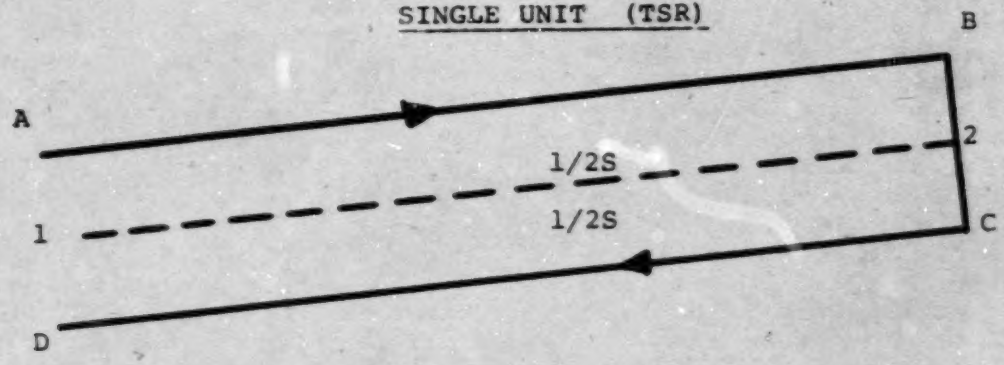
The operational procedure for the TSR type of search pattern is to cruise along the intended track of the sought craft, from its last known position to its intended destination, at a distance of 1/2S off of the original track. The track of the search unit is down wind or down current of the intended track of the craft being sought. Return track by the search unit is parallel to the original search track at a distance of 1/2S on the other side of the intended track. The TSN pattern is executed by cruising on the track of the sought craft returning at a spacing of S and going back on the other side at a spacing of S.

4. *Method of Designation is:*

A to B to C, or A to B to C and return.

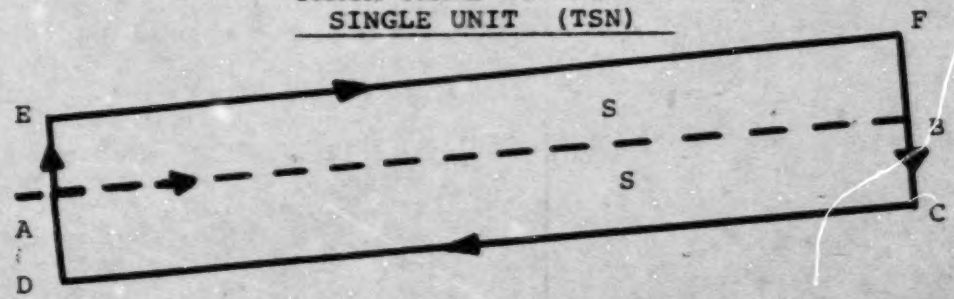
Navigational aids may be used for designating intended track of small surface craft.

TRACK CRAWL RETURN
SINGLE UNIT (TSR)



1 denotes last known position
2 denotes intended destination of distressed unit
A to B denotes first track for return search TSR
C to D denotes return track for return search TSR

TRACK CRAWL NON-RETURN
SINGLE UNIT (TSN)



A denotes last known position
B denotes intended destination of distress unit
A to B denotes first search track for non-return search TSN
C to D denotes second track for non-return search TSN
E to F denotes third track for non-return search TSN

PARALLEL TRACK PATTERN (P)

1. *Purpose*: For search of an area when
   a. Search area is large (Usually rectangular or square)
   b. Uniform coverage is desired,
   c. Position of the target is known only approximately.

2. *Symbol designations are*:
   a. Single unit is Papa Sierra (PS)
   b. Multi unit is Papa Mike (PM)

3. *Pattern Operation*:
   a. The search Unit proceeds to a corner of the search area and sweeps the area maintaining parallel tracks, the first of which is at a distance of 1/2S from the side of the area. Tracks are parallel to the longer side of the rectangle. At the end of each leg, the search unit turns at a distance 1/2S from the end of the search area and moves over the cross leg, a distance of S to the next leg.
   b. When two or more search units are used, they cruise in an abeam formation. One unit is designated as guide, and handles navigation, communications, and exercises control of the other unit or units of the formation. The units search on parallel tracks at a distance of S apart. At the end of each search leg the units turn together 90 degrees and proceed for a distance equal to the track spacing multiplied by the number of search units in the team. Turns are carried out by signal from the guide unit.

4. *Method of Designation*:
   a. Center Point_____ North_____ West Axis____ True____ Miles by_____ Miles Creep (*direction*)
   b. May also be designated by geographical coordinates.

CREEPING LINE PATTERN (C)

1. *Purpose*

   For use when survivors or distress unit is reported between two points, but exact position is not known. For search of a track when the distress position or survivors may be to either side of the track due to navigational error or target drift. Used for search of a long and rectangular area where width is greater than can be covered by the track crawl pattern. Search is started on the end of the track at which the greatest probability of survivors is believed to exist, resulting in coverage of the most probable area first.

2. *Symbol designations are:*
   a. Single unit is Charlie Sierra (CS)
   b. Multi unit is Charlie Mike (CM)

3. *Pattern Operation*

   Single or multi unit operation of this pattern is identical to that of the parallel track pattern except the search tracks are perpendicular to the long axis of the rectangle.

4. *Method of Designation*

   The same designation used for the parallel track pattern is also used for the creeping line pattern. Geographical coordinates may also be used.

SQUARE PATTERN (S)

1. *Purpose*

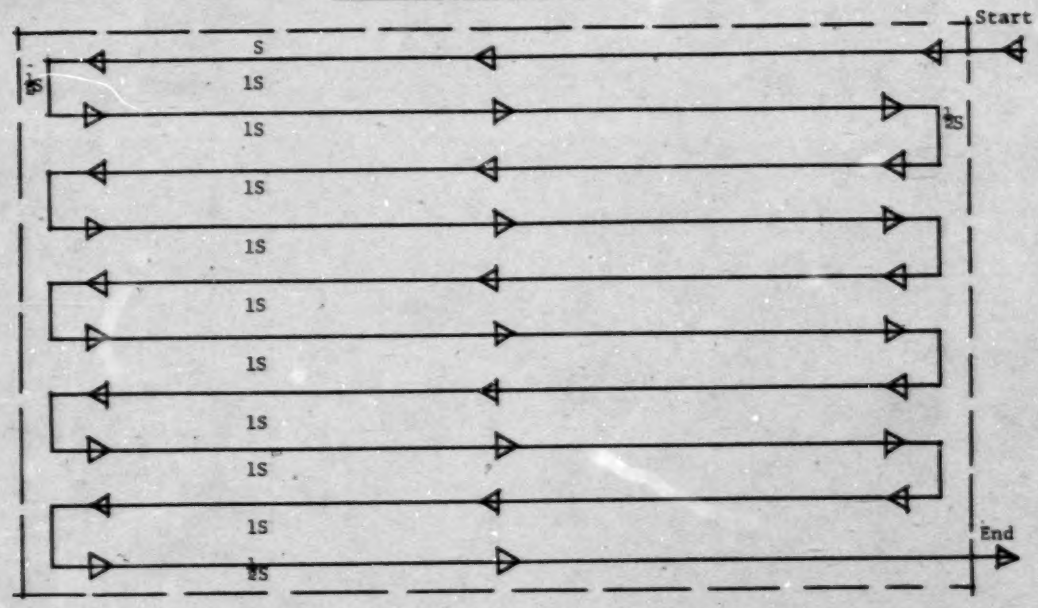
   For use when the position of distress or survivors is known within close limits and the area to be searched is not extensive. To increase probability of detection, several units may be used at the same time to make repeat searches of the area.

2. *Symbol designations are:*
   a. Single unit is Sierra Echo (SE)
   b. Multi unit is Sierra Echo Mike (SEM)

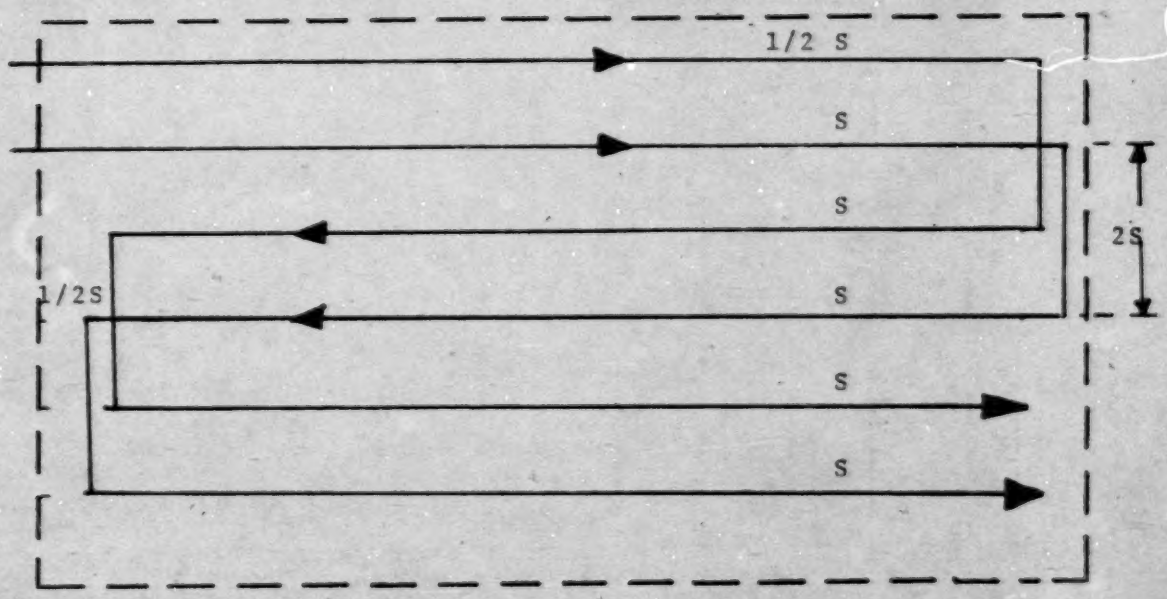
3. *Pattern Operation*

   The expanding square search is not suitable for employment of two or more units searching in an abeam formation, due to difficulty of keeping abeam during the frequent turns. If several search units are used, they should search independently, each unit starting a separate expanding square pattern at the estimated distress position. The second search by a single unit is inclined 45° from the track of original search track and originating from the starting point. When several units are employed the starting time of the units is staggered to avoid traffic conflict and their axis of search is at a 45° incline to the track of the unit ahead. The pattern consists of an expanding square, the parallel sides of which are S distance apart. Pattern will operate in a clock-wise direction around center point.

PARALLEL TRACK PATTERN (P)

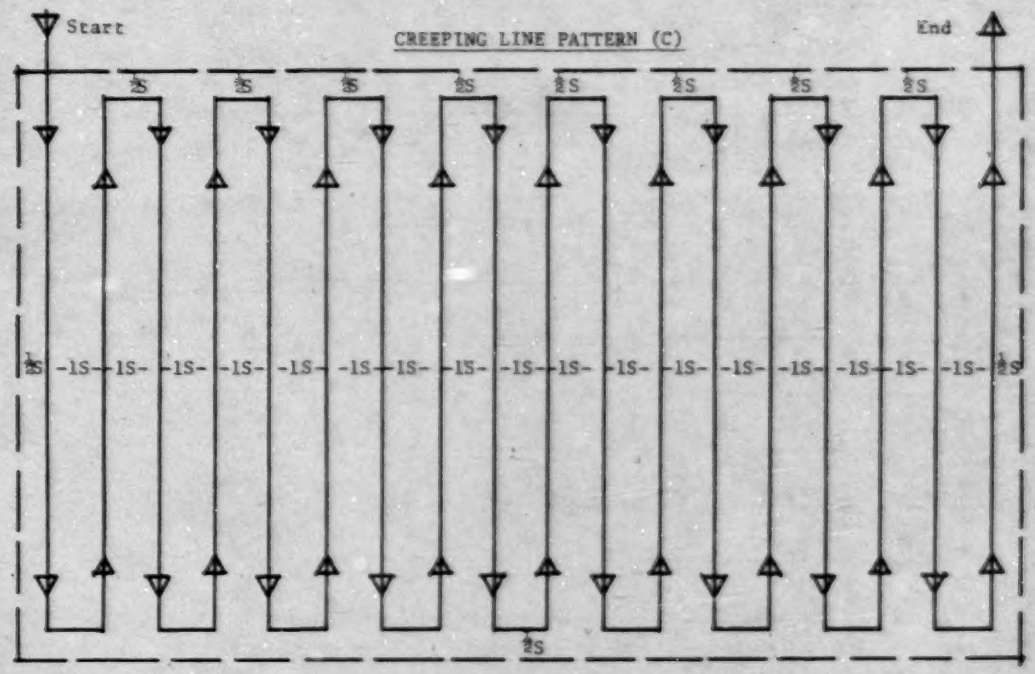


PARALLEL TRACK SINGLE UNIT PS

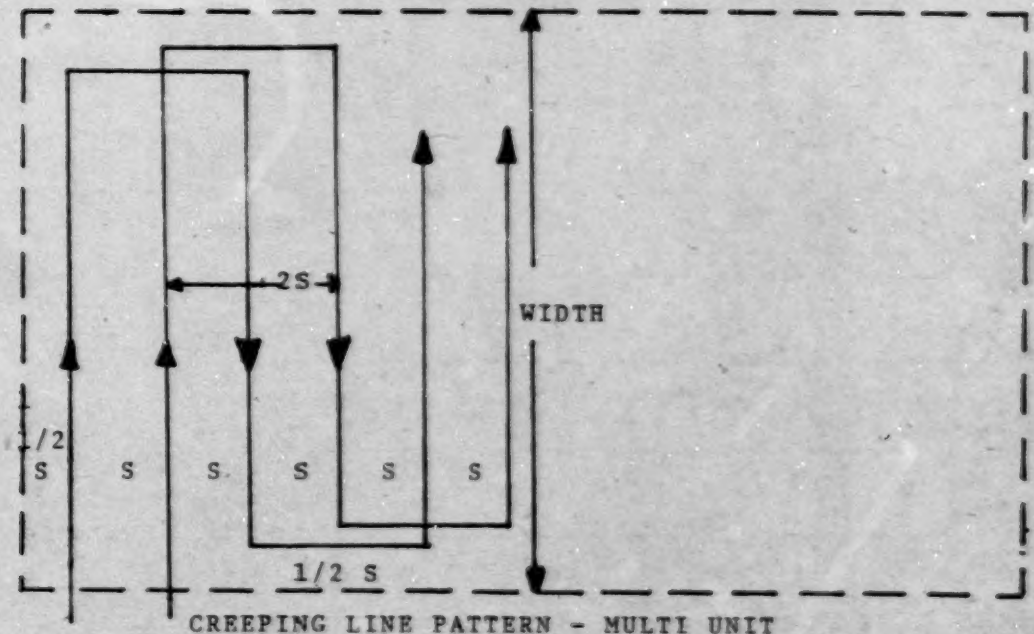


PARALLEL TRACK MULTI UNIT (PM)

Broken line denotes search area.



CREEPING LINE PATTERN - SINGLE UNIT



CREEPING LINE PATTERN - MULTI UNIT

Broken line denotes search area.

4. *Method of Designation is:*
Center Point_____ North_____ West
Radius First Search_____ Miles
Radius Second Search_____ Miles
Radius Third Search_____ Miles
This method of designation is the same for a single unit, which may make up to three searches, or for multi units.

SECTOR PATTERN (V)

1. *Purpose*

For use when the position of distress or survivors is known within close limits and the area to be searched is not extensive. It is simpler to execute than the expanding square. Its principal advantage is that the search craft repeatedly crosses DATUM on each crossing of the pattern.

2. *Symbol Designations are:*
   a. Single unit is Victor Sierra (VS)
   b. Multi unit (Two Boats) is Victor Mike (VM)

3. *Pattern Operation*

Each leg is separated by a 60° angle. Three crosslegs and three chord legs are executed, always turning to starboard with a relative heading change of 120° whenever the radius of search circle is reached. The time required to complete one search can be found by multiplying the appropriate time in the chart below, by 9.

Search Radius	Minutes on Leg at Speed of 5 Kts.	10 Kts.	15 Kts.
1 NM	12	6	4
2 NM	24	12	8
3 NM	36	18	12
4 NM	48	24	16
5 NM	60	30	20

Angles other than 60° can be used but this angle is most useful for Auxiliary SAR surface craft.

In a VM pattern the second boat begins its search from the same datum as the first but with its first leg 90° to the left of the first boat's leg. The second boat should let the first one get one leg ahead so that they do not cross datum at the same time.

4. *Method of designation is*
Center Point_____ North_____ West
Radius first search_____ Miles

PARALLEL SWEEP SEARCH (PP)

1. *Purpose*

For search of a long rectangular area when distance or time element is such that only one sweep out and return is possible. Two or more search units are required. The parallel sweep search is used when simultaneous sweep of an area is desired using a large number of search units. An area may be saturated with units, increasing probability of detection, as may be desired on bays, rivers and lakes when a person falls or is washed over-board. This pattern affords maximum use of untrained operators with craft usually on or near the distress scene.

2. *Symbol Designation is:*
Papa Papa Mike (PPM)

3. *Pattern Operation*

All units proceed to the last reported position of the distress, then divert to their respective "out" search tracks. Craft with untrained operators are placed abeam of Coast Guard or Auxiliary units. Presuming all search units will make a return track, the initial search tracks are separated at a distance of 2S. This places a distance of S between the "out" and "in" tracks. When sufficient numbers of search craft are available to cover the entire search area in one sweep, the initial search tracks are separated by a distance of S. In the search operation, the units proceed together as a search team on their assigned tracks, in an abeam formation.

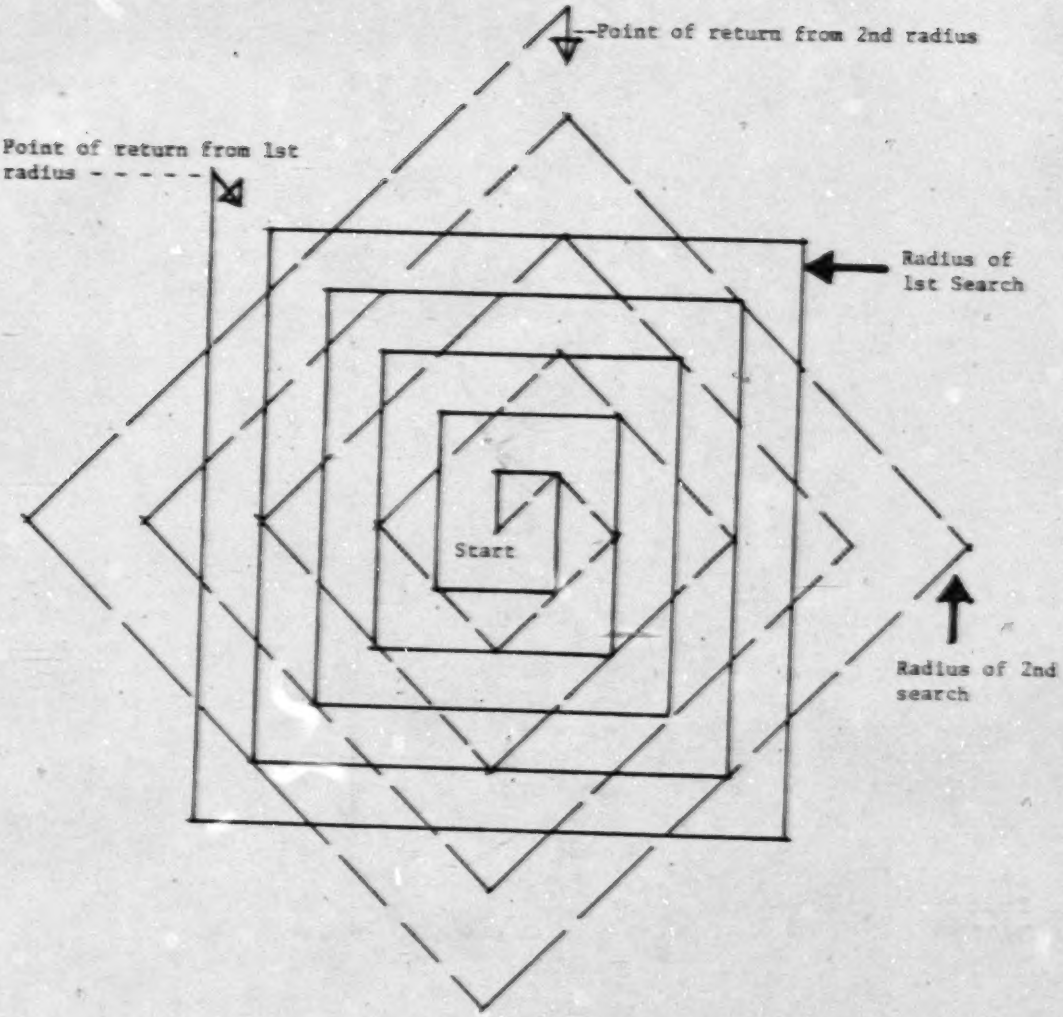
4. *Method of Designation is:*
Out_____ North_____ West to_____
North_____ West_____
In_____ North_____ West to_____ North _____ West

AIR SURFACE TEAM SEARCH

1. *Purpose*

The chief advantage of this type of search is that it permits more accurate navigation of the selected search pattern by aircraft operating in open sea, where navigation aids may not be available. This coordinated air and surface craft team search consists of the aircraft flying the creeping line pattern, flying tracks at right angles to the course of the surface vessel which uses the track crawl pattern. The track of the aircraft is laid out so that the advance of the plane equals that of the surface vessel so as to cause the aircraft to pass over the surface craft

SQUARE PATTERN (S)

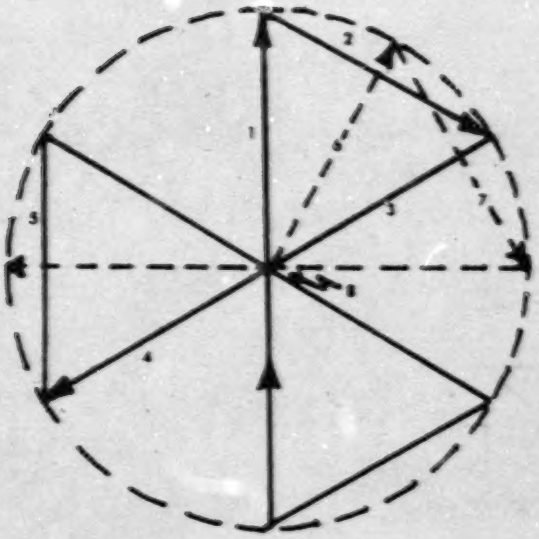


Solid line denotes 1st search - tracks 1S apart.

Broken line denotes 2nd search - tracks 1S apart - inclined 45°.

Pattern tracks move clock-wise.

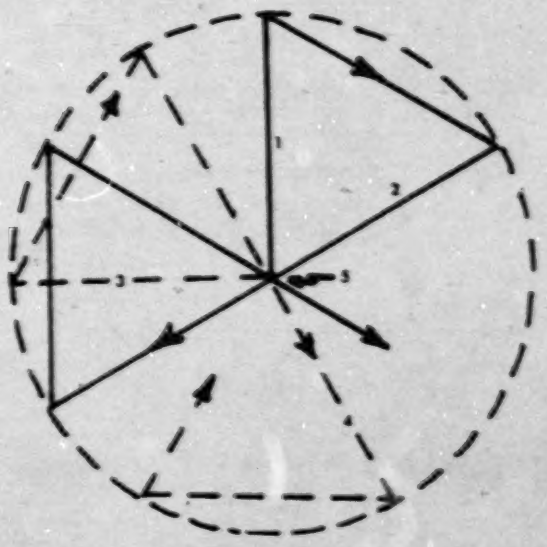
SECTOR PATTERN (V)



1. First Leg-First Search
2. First Crossleg-
   First Search
3. Second Leg-First Search
4. Third Leg-First Search
5. Second Crossleg-
   First Search
6. First Leg-Second Search
7. First Crossleg-
   Second Search
8. DATUM

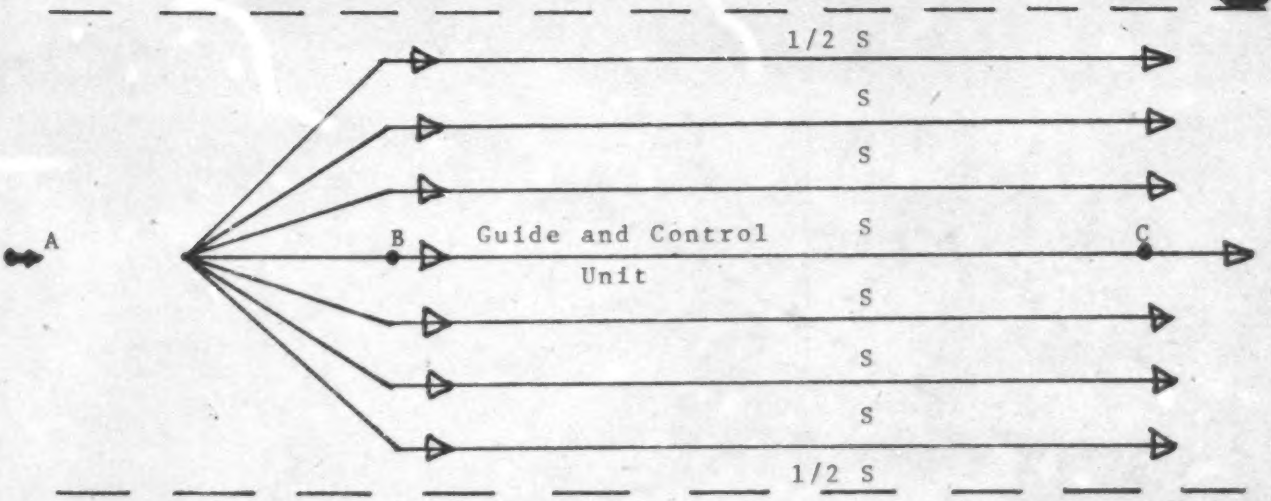
Sector Search Pattern-Single Unit.

1. First Leg-First Boat
2. Second Leg-First Boat
3. First Leg-Second Boat
4. Third Leg-Second Boat
5. DATUM

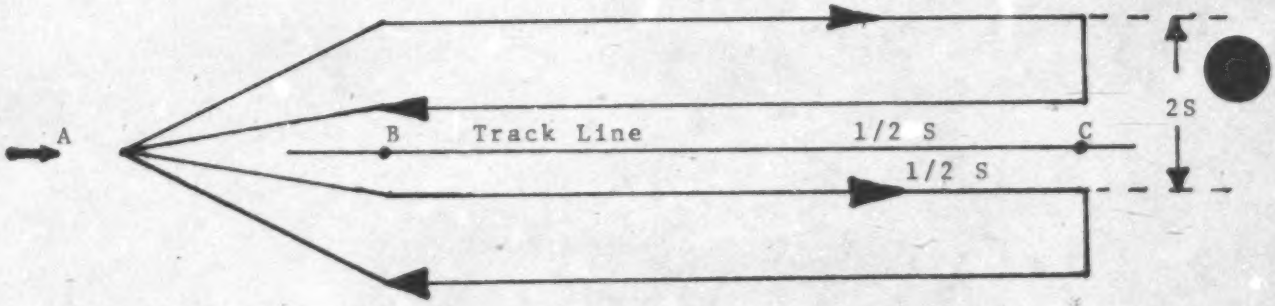


Sector Search Pattern-Multi-Unit.

PARALLEL SWEEP SEARCH (PP)



SINGLE SWEEP NO RETURN



SWEEP WITH RETURN

A. Denotes Search units point of departure.

B. Denotes last reported position of the distress unit or starting point.

C. Denotes distress unit's intended point of destination or limit of the search area.

on each leg. Computation of the track spacing, ship speed and length of aircraft search legs are determined by a series of formulae as shown in the National SAR Manual. One or more aircraft may be used in this team search. The surface vessel usually provides the communication service with the Rescue Coordination Center.

2. *Symbol designations are*:
   a. Single unit coordinating is Charlie Sierra Charlie (CSC)
   b. Multi unit coordinating is Charlie Mike Charlie (CMC)

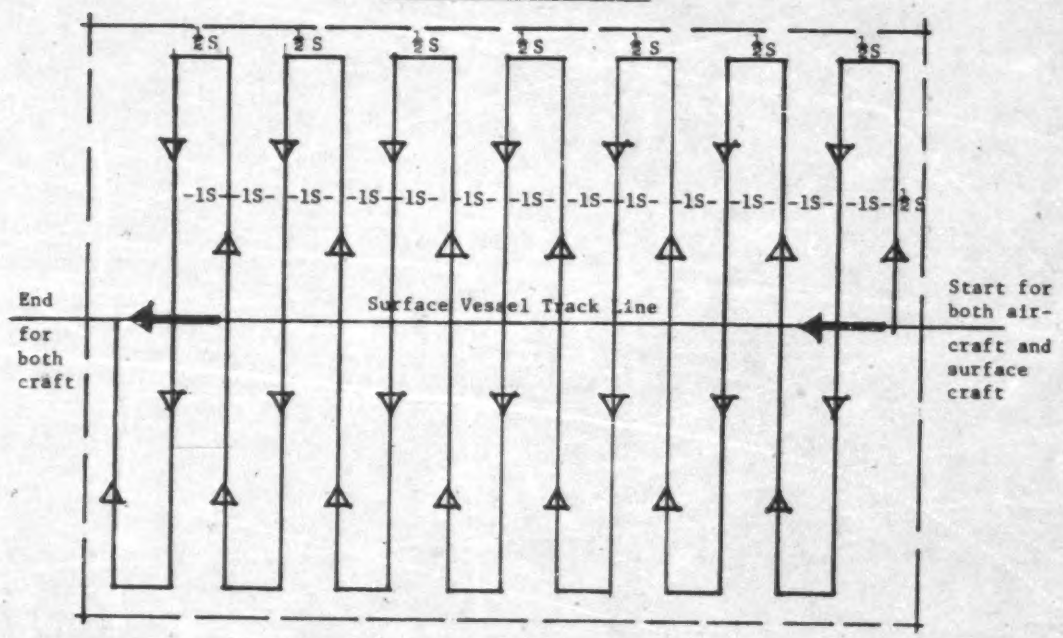
3. *Pattern Operation*:
   Creeping line for aircraft. Track crawl for surface craft.

4. *Method of designation*:
   Same as stated for each pattern.

SEARCH PATTERN SUMMARY

Pattern Designation	Type	Units Required	Remarks
TSR	Track Crawl, Return Single unit	1 aircraft or 1 ship	For search of a track line, or line of position when unit must break off search at same end of track as originated on.
TMR	Track Crawl, Return Multi-Unit	2 or more aircraft or 2 or more ships	Same as TSR except that two or more units are used cruising abeam.
TSN	Track Crawl, Non-Return Single unit	1 aircraft or 1 ship	Same as TSR except that search terminates at opposite end of track from start point.
TMN	Track Crawl, Non-Return Multi-unit	2 or more aircraft or 2 or more ships	Same as TSR except that search terminates at opposite end of track from start point, and two or more units are used cruising abeam.
PS	Parallel Track Single Unit	1 aircraft or 1 ship	Search of an area when the position of the distress is unknown.
PM	Parallel Track Multi-Unit	2 or more aircraft or 2 or more ships	Same as PS except that two or more units search in abeam formation at distance S apart for faster and greater area of coverage.
PP	Parallel Sweep	2 or more aircraft or 2 or more ships	For use in search of a long rectangular area where only one sweep out and back is possible.
CS	Creeping Line Single Unit	1 aircraft or 1 ship	For use when survivors or distress are reported to be between two points, but position is not known. Covers a wider area than track crawl plans.
CM	Creeping Line Multi-Unit	2 or more aircraft or 2 or more ships	Same as CS except that two or more units are used cruising abeam.

AIR-SURFACE TEAM SEARCH



denotes surface vessel track line (track crawl)

denotes aircraft track line (creeping line)

Broken line denotes search area.

SEARCH PATTERN SUMMARY (Continued)

Pattern Designation	Type	Units Required	Remarks
CSC	Coordinated Creeping Line Single Unit	1 Aircraft *and* 1 Vessel	For use when distress is reported between two points but position is not known; also used for track search. Coordinated for more accurate search tracks.
CMC	Coordinated Creeping Line Multi-Unit	2 or more Aircraft *and* 1 Vessel	Same as CSC except that two or more aircraft flying abeam are used with ship.
SE	Expanding Square Single Unit	1 aircraft or 1 ship	For use when position of distress of survivors is known within close limits and area to be searched is not extensive.
SEM	Expanding Square Multi-Unit	2 or more aircraft or 2 or more ships	Same as SE except that it is desired to employ several units in the same pattern but searching independently.
VS	Sector Single Unit	1 aircraft or 1 ship	Object being searched for is small and position of distress is known within close limits.
VM	Sector Multi-Unit	2 or more aircraft or 2 or more ships	Same as VS, but two or more search units are used.

SELECTION OF SEARCH PATTERNS

The selection of search patterns may well be the difference between success or failure of a search mission. Often only one type of pattern will be used. In other cases, several patterns or a sequence of patterns will have to be employed. The type of search to be conducted will generally depend on the following factors:

1. *Accuracy with which the Position of Distress is Known*

Some search and rescue operations involve little or no difficulty in the search phase. The incident may have been witnessed, the distressed unit may have signaled its exact position, or the whereabouts may be related to something of a definite nature, such as a landmark or fix taken a short time before the accident. In such cases, the search area can be determined within narrow limits and search pattern employed to give high probability of detection in a minimum of time.

Often no news of the distress is received until the craft is overdue at its destination. In some cases the intended track is known, but in others, only the general area of operations of the missing unit may be available. Aircraft in particular are subject to large errors in position, and cases are on record of aircraft crashing hundreds of miles off track after becoming lost. With surface vessels, a considerable time may have elapsed between occurrence of the distress and failure of the vessel to arrive at its destination. During such a time lapse, wind and sea currents may have displaced survivors a considerable distance from the track line. Such incidents may require the SAR Mission Coordinator to initiate a search over a vast area. Such a search will invariably be complex in nature, and will involve many search units for long periods of time. The selection of the types of search patterns, and the course of action to be taken in such an operation, will require careful planning.

Wind and current exert a considerable effect on search operations. There is always a possibility that the effects of wind and sea

currents may necessitate a shift of search areas, especially if the search efforts last more than a few hours. If the search is long, careful records must be kept of the areas searched. A change in the wind direction may cause a raft to drift into an area previously covered thoroughly. This is especially true when search units are able to cover only a small area daily because of the great distance from base to the search area. Drift also becomes a factor when, due to shortages of search units, an area must be searched piecemeal over a long period of time. Because of the drift factor, coverage by a large number of units early in the search is desirable. If this is not possible, the position or track line must be altered to account for drift.

2. *Number and Type of Search Aircraft and Ships Available*

The primary rescue organizations normally do not have sufficient aircraft and vessels for prolonged searches of large areas. When the need for such a search arises, rescue forces must be augmented by search units from other agencies. A shortage of search units will force a reduction in the area covered, a reduction in the probability, or an increase in the time required for coverage of an area. A saturation coverage of the search area by a large number of units during the early stages of a search is nearly always preferable to a piecemeal coverage by a few units over a long period of time. The number and type of search units available will be one of the controlling factors in selecting the type of search patterns to be used.

3. *Weather Conditions*

Weather conditions will affect the sweep width and thereby the track spacing to be used by search units. Weather will also have an effect on the navigational accuracy of the search units. Under adverse weather conditions, search patterns must be selected that will allow the best navigation and most accurate track spacing.

The approach of bad weather may also place a time limit on search operations requiring the coverage of the area to be accomplished before the weather deteriorates.

4. *Availability of Navigational Aids for Search Units*

The navigational accuracy with which a search unit is able to execute a search pattern will have a most important effect on the probability of detection. In many areas navigation aids are limited or lacking and search patterns must be selected that provide navigational aid.

5. *Distance of the Search Area from Search Base*

The distance of the search area from search bases must be considered. The assignment of search units to an area so far from base that only a very short time can be spent searching should be avoided if possible. Coverage effectiveness increases after the search units settle down on a search. The assignment of very small areas at great distances from base to many individual units will result in overlapping of areas and inefficient coverage. It is usually better to form a multi-craft unit and attempt to cover a large area by a combined effort to prevent duplication and overlapping of areas. The use of a parallel sweep pattern or employment of "Air-Surface Team" patterns in areas far from search bases will help prevent such duplication and overlapping.

6. *Time Limitation*

Time is often of vital importance. The time available may depend on the temperature of the water, weather moving into the search area, elapsed time since occurrence of the distress, and whether survivors are in the water, life rafts or life boats. The ranges of survival time given below are based on the assumption that the survivor is clothed in ordinary clothing, is in good physical condition, and when immersed in water has a life preserver.

Water Temperature	Expected Time of Survival of Men Immersed in the Sea
Less than 35°F	Less than 3/4 hours
35°F to 40°F	Less than 1½ hours
40°F to 50°F	Less than 3 hours
50°F to 60°F	Less than 6 hours
60°F to 70°F	Less than 12 hours
Over 70°F	Indefinite (depends on fatigue)

With a limited number of search units, if time becomes the controlling factor, either the probability or the area covered must be reduced in order to complete the coverage of the area in the required time limit.

7. *Time of Day*

   During early stages of a search, or with high winds and seas, night search is usually desirable due to the greater sighting range of night pyrotechnics and lights.

8. *Size of the Target*

   The type and size of the target will influence the choice of search patterns. The larger the target, the greater will be the track spacing. With wide track spacing, search units can be employed in single unit searches. With small targets and close track spacing, multi-unit searches should be used whenever feasible. Also to be considered is the ability of survivors to render assistance by any visual, radio or radar location aids they possess. If survivors use these aids, the detection range is greatly increased. A small target with detection aids is likely to be sighted at a greater range than a large target with no aids available.

9. *Probability Desired*

   Certain search patterns will permit close track spacing. The most accurate patterns in this respect are the "Air-Surface Team" patterns, or those patterns which are so oriented that search units have periodic contact with a navigational reference point. With small objects, close track spacing is required if probability is to be high. If the use of high accuracy search patterns is not possible, probability will be reduced. With very small objects, the track spacing required is so close that it is physically impossible for the search unit to make good the tracks required. Probability can be increased in such cases by repeated searches in the same area.

DETERMINING CONTROLLING FACTORS

Of all the factors involved in the selection of search patterns, one or more may prove so important in a particular situation that the others can generally be regarded as secondary, or disregarded entirely. These important factors are called *controlling factors*, and are the ones to be considered in determining the type search to be executed. For example, with a limited number of search units, the following factors may be considered:

1. Inaccurate position of distress requires a larger search area at expense of
   a. Time, or
   b. Probability
2. Limited time for search requires rapid coverage at expense of
   a. Area covered, or
   b. Probability or
   c. Time of day
3. High probability requires close track spacing at expense of
   a. Area covered, or
   b. Time

The above illustrates a few of the factors that must be considered. In any of the above situations, additional search units would alleviate the situation to some extent, but there is a practical limit to the number of search units that can be safely and effectively utilized in an area.

With the realization that emphasis on any factor will usually be at the expense of others, the search planner must decide which factor or factors are the most important. When this has been done, the search patterns and search operations are planned to meet the requirements of the controlling factors while satisfying other requirements as nearly as possible.

DETERMINING THE SEARCH PATTERN AND COURSE OF ACTION

After determining the controlling factors, several search patterns may be tentatively selected. A search may consist of only one search pattern, or it may involve many search patterns in a planned sequence. Time permitting, the search patterns should be listed, together with the advantages and disadvantages of each, and compared. From this comparison, the search pattern should be selected that appears to best satisfy requirements of the controlling factors. It should then be examined for suitability, feasibility and acceptability. A search pattern is suitable if, either alone, or in combination with others, it will accomplish the mission within the required time limits; it is feasible if it can be carried out with units available in the face of weather, distances, and conditions existing at the time; it is acceptable if the results to be obtained from its execution are worth the estimated effort and cost.

During large scale searches, ample time is usually available for planning, and it is essential that careful thought go into employment of search units. Once a large scale search is launched, redeployment is often exceedingly difficult. Such action may well nullify the effectiveness of an entire day's search at a crucial period. Even if time does not permit a written estimate and analysis, the planner must mentally consider all the factors involved.

CHAPTER IX

SAR COMMUNICATIONS

The mission of SAR communications is to obtain rapid and reliable information on distress or possible distress incidents from the source or scene and to disseminate it to all activities capable of providing assistance. SAR communications also provide the SAR Coordinator with a means of exercising command authority.

RESPONSIBILITY FOR SAR COMMUNICATIONS

The SAR Coordinator or Mission Coordinator is responsible for disseminating instructions concerning SAR frequencies to activities participating in SAR operations. The SAR Coordinator, Mission Coordinator, or On-Scene-Commander, when designated, is responsible for establishing reliable communications between participating vessels, aircraft, RCCs and appropriate civilian agencies.

SAR COMMUNICATION FACILITIES

a. *SAR Radio Facilities*

1. U.S. Coast Guard Communication stations, secondary radio stations, aeronautical radio stations, Group Communications facilities, land mobile radio stations, ship stations, aircraft stations, aircraft stations and radio equipped shore units.
2. Coast Guard Auxiliary fixed land and land mobile radio stations, aircraft and vessel stations.
3. U.S. Air Force, U.S. Army, U.S. Marine Corps and U.S. Navy radio stations and direction finder stations.
4. Federal Aviation Agency radio stations.
5. Coastal radio stations (commercial)
6. Coastal harbor radio stations (commercial).
7. Federal Communications Commission direction finder stations.
8. Maritime mobile ship stations.

b. *SAR Teletypewriter Facilities*

1. U.S. Air Force, U.S. Army, U.S. Coast Guard, and U.S. Navy owned and leased direct teletype networks.
2. Military Automatic Digital Network (Autodin)
3. Western Union Company Teletypewriter Exchange Service (TWX) and (TELEX)
4. Federal Aviation Agency landline and radio teletype networks.
5. Other leased teletypewriter facilities.

c. *SAR Telephone Facilities*

1. Commercial business telephones.
2. Leased private lines (hot lines).
3. U.S. Air Force, U.S. Army, U.S. Coast Guard and U.S. Navy owned and leased direct telephone service.
4. Leased tie lines.
5. Military Automatic Voice Network (Autovon)
6. Federal Telephone System (FTS)

SAR COMMUNICATION ORGANIZATION

The RCC is the focal point of SAR communications, since most communications in a SAR incident originate in, or are addressed to, the RCC. SAR communications must be organized to provide the following:

1. Continuous radio watches, at selected locations, on the distress frequencies.
2. Means of receiving, reporting and disseminating information concerning actual or possible SAR matters on a priority basis as required.
3. Sufficient reserve of personnel adequate to handle communications during peak loads arising from SAR matters.
4. Sufficient trained personnel to man additional communications circuits and direction finding equipment during SAR incidents.
5. SAR communications planning must be based on continuous operation of major SAR facilities.

COORDINATION OF SAR COMMUNICATIONS

The coordination of operational communications relating to SAR incidents closely follows the command

structure. The SAR Mission Coordinator is the controlling authority during a SAR incident and as such is responsible for coordinating all communications related to the incident. In this regard, the SAR Mission Coordinator designates a primary and a secondary frequency in each frequency band (HF, VHF and UHF) for the coordination of SAR units on the scene. SAR units will normally report in to the OSC on one of the designated primary frequencies. Also, if appropriate, a primary and secondary SAR control frequency will be designated for the purpose of passing traffic between the OSC and the radio station serving the RCC. The OSC always remains subject to the instructions and the direction of the SAR Mission Coordinator. A Unit will not be designated as OSC if his communications capabilities are inadequate for the particular incident.

The OSC controls communications at the scene. In the control of communications at the scene, the capabilities of the various communications equipments carried by SAR units must be considered. Invariably certain units will have a capability to shift frequencies in less than a minute, while others may require five minutes to tune a transmitter on the new frequency. Therefore, prior to shifting frequencies between SAR units, explicit instructions must be issued concerning procedures to be followed in case communications are lost.

GENERAL SAR FREQUENCY INFORMATION

1. The following frequencies are normally employed in SAR operations:

- 500 kHz–(MF/CW) International radiotelegraphy Distress and calling.
- 2182 kHz–(MF/V) International radiotelephony Distress and calling.
- 3023.5 kHz–(HF/V) International HF On-Scene, air and surface.
- 5680 kHz–(HF/V) International HF On-Scene, air and surface.
- 8364 kHz–(HF/CW) International lifeboat, life raft and survival craft.
- 121.5 MHz–(VHF/AM) International aeronautical emergency.
- 156.8 MHZ–(VHF/FM) U.S. Distress, Safety, and Calling; and International calling and safety frequency for the maritime mobile service in the VHF/FM band.
- 243.0 MHZ–(UHF/AM) Military common emergency and international survival craft frequency.

2. *Control of Distress Traffic*

The control of distress traffic is the responsibility of the station in distress or of the station which has been delegated the control.

INITIAL COMMUNICATIONS

Initial communications between a vessel in distress and the mobile units proceeding to its assistance are normally on the frequency which was used by the vessel in declaring the emergency or distress. This is usually 2182 kHz or 156.8 MHz.

Because aeronautical distress procedures normally call for the first transmission of the distress information to be on the frequency in use for normal communications at the time of the incident, SAR craft proceeding to the assistance of an aircraft must obtain frequency information from the controlling surface radio station.

CONTINUING COMMUNICATIONS

After initial communications have been established, the selection of a frequency for traffic between vessel/aircraft in distress and the rescue units is the responsibility of the mobile station in distress or the station which transmitted the distress message, except when control of distress traffic has been delegated to another station.

SAR ON-SCENE FREQUENCY

This frequency is for use by the SAR units on-scene when communicating among themselves.

SAR CONTROL FREQUENCY

This frequency is for use between the SAR Mission Coordinator at RCC and the On-Scene-Commander. The format used for SITUATION REPORTS (SITREP) messages between SMC and OSC is discussed in the Auxiliary COMMUNICATION COURSE.

INTERNATIONAL DISTRESS SIGNALS

The following distress signals are recognized by international conventions and should be familiar to all SAR personnel:

a. A gun or other explosive signal fired at intervals of about a minute.
b. A continuous sounding with any fog-signaling apparatus.
c. Rockets or shells, throwing red stars fired one at a time at short intervals.
d. A signal made by radiotelegraphy or by any other signaling method consisting of the group . . . – – – . . . (SOS) in the Morse Code.
e. A signal sent by radiotelephony consisting of the spoken word "MAYDAY."
f. The International Code Signal of distress made by displaying the flags NOVEMBER CHARLIE (NOVEMBER is a blue and white checkerboard flag; CHARLIE is a horizontally striped flag

with stripes of blue, white, red, white, blue, in that order).

g. A signal consisting of a square flag having, above or below it, a ball or anything resembling a ball.
h. Flames on a vessel (as from a burning tar barrel, oil barrel, etc.).
i. A rocket parachute flare or a hand flare showing a red light.
j A smoke signal giving off a volume of orange-colored smoke.
k. Slowly and repeatedly raising and lowering arms outstretched to each side.
l. The radiotelegraph alarm signal consisting of a series of twelve dashes sent in a minute, the duration of each dash being 4 seconds and the duration of the interval between 2 consecutive dashes being 1 second. (This may precede the distress call SOS).
m. The radiotelephone alarm signal consisting of 2 tones transmitted alternately over periods of from 30 seconds to 1 minute. (This may precede the distress call "MAYDAY").

AUXILIARY COMMUNICATIONS COURSE

The Coast Guard Auxiliary Communications Specialty Course should be taken by all SAR personnel. SITREPS (Situation Reports), prowords, distress frequency usage and message addressing are all covered in detail in the course.

AIRCRAFT EMERGENCY PROCEDURE FOR ATTRACTING SURFACE CRAFT

The following procedures performed in sequence are employed by aircraft to direct a surface craft towards an aircraft or surface craft in distress:

1. Circling the surface craft at least once
2. Crossing the projected course of the vessel close ahead at a low altitude, opening and closing the throttle or changing the propeller pitch
3. Heading in the direction in which the surface craft is to be directed
4. Repeating if necessary

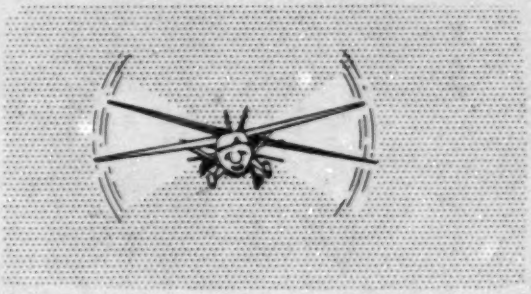
When assistance of the surface craft to which the signal is directed is no longer required, aircraft performs the following procedure:

1. Crossing the wake of the vessel close astern at a low altitude, opening and closing the throttle or changing the propeller pitch.

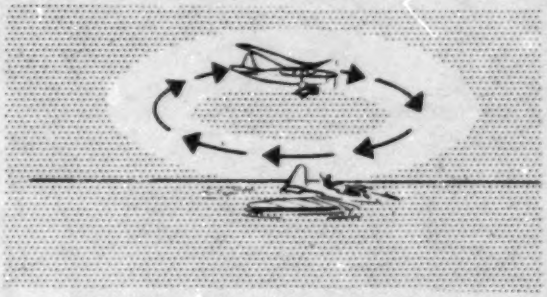
Normally a change of heading will be made by the surface craft as an acknowledgement that the direction has been received and will be complied with. If the surface craft is unable to comply, it will so indicate by hoisting the international flag "N", or by other visual or radio means.

AIRCRAFT ACKNOWLEDGMENT SIGNALS

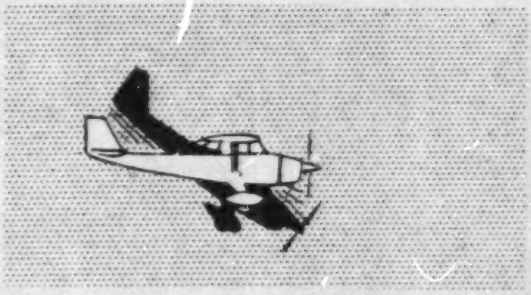
The following four signals performed by aircraft are standard acknowledgment to surface or surface craft.



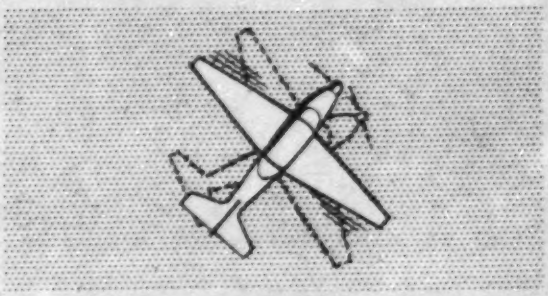
MESSAGE RECEIVED AND UNDERSTOOD



MESSAGE RECEIVED AND NOT UNDERSTOOD



AFFIRMATIVE



NEGATIVE

MISCELLANEOUS SURFACE TO AIR SIGNALS

The following signals performed by a person on the surface are standard surface-to-aircraft body signals. The person performing these signals should wear clothing that contrasts to the deck or surface background and stand in as open an area as possible. A white or brightly colored cloth should be used when performing the affirmative and negative signals.

Affirmative (Yes)

Negative (No)

Our receiver is operating.

Do not attempt to land here.

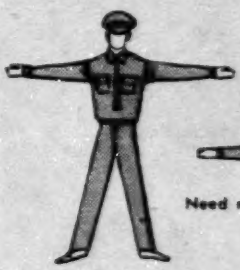
Land here. (Point in direction of landing.)

Use drop message

All O.K. Do not wait.

Can proceed shortly—Wait if practicable.

Pick us up—Plane abandoned.



Need mechanical help or parts—Long delay.

Need medical assistance—Urgent.
Lie Supine

CHAPTER X

SAR SEAMANSHIP

The objective of this course is to provide Auxiliarists with SAR knowledge so, when necessary, they can be integrated into the operative network of the Coast Guard, in order to afford greater protection of life and property through increased efficiency. It is therefore of the utmost importance that the SAR student have the knowledge stressed in the Basic Qualification Courses.

Four basic qualifications required:

1st –Plotting a course on a chart.
2nd–Apply vessel's speed curve to the course.
3rd –Apply compass deviation table to the course
4th –Ability to run a vessel on course.

Without these basic qualifications an Auxiliarist cannot operate his vessel safely at night, in fog or squalls, nor can he give accurate Estimated Time of Arrivals (ETA), all of which are necessary in Search and Rescue Operations.

The fourth basic qualification, the ability to operate a vessel on a course is the result of practice and experience. To assist in this, Search and Rescue Drills should be conducted by Flotillas and Divisions. However, an important phase of operating a vessel is an understanding of it. For instance, the operator should know what it will do in rough weather; and also know if the tanks were cleaned of sediment, lint, dust, dirt and water before it went into service at the start of the boating season. Rough weather quickly stirs up these foreign matters and can plug a filter, gas line, or cause carburetor trouble in a very short time. This sort of trouble will make a vessel a liability to a SAR mission and another Distressed Vessel for rescue.

The requirements of the Facility Inspection include most of the items of equipment that must be on board for performing the task when the SAR vessel reaches the distressed vessel. Some districts require additional items which should be stowed on board at all times.

The important point is not only to have equipment aboard but have it ready, accessible and in good condition. Do not litter decks with unnecessary equipment but keep working areas clear.

TECHNIQUE OF PASSING A LINE

Passing a line is a technique employed in nearly every assist or rescue attempted and yet, despite its importance, is taken for granted by most boatmen.

When heading toward a vessel dead in the water with intentions of passing a line, do not run too close if there is strong wind or sea running. Wind and current directions will dictate approach.

While preparing for approach have the crew ready the heaving line. A medium weight line with a "monkey's fist" in the heaving end is recommended. Make certain that the line is coiled and held so it will open like a spring and does not foul in a snarl or tangle in mid air. If possible always be windward when heaving the line.

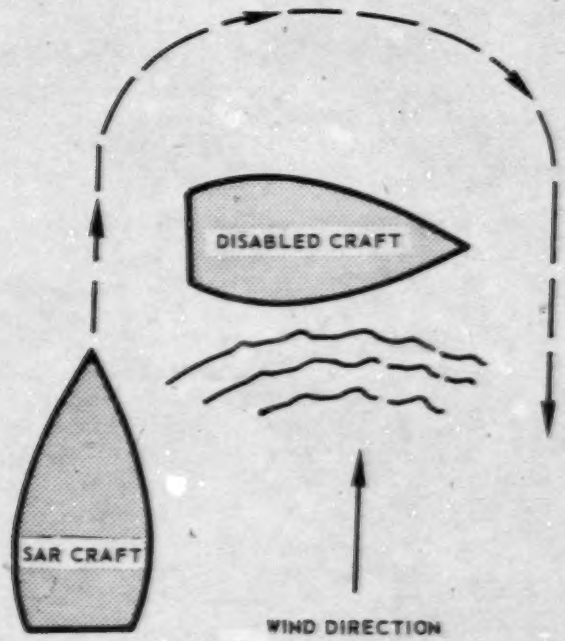
The usual position for a disabled vessel adrift to assume would be with the wind abaft the beam. Assume the starboard side is facing the wind. Go down wind past her stern and give instructions as to how the rescue will be attempted. If conditions of the sea permit, it may be advisable to stop parallel astern of the disabled craft and drift long enough to determine and compare the approximate rates and direction of drift. If the rescue vessel is drifting faster, go up on the leeward side and if slower go to the windward side, should it become necessary to approach very close to the distressed craft to pass the line.

After testing the wind and drifting past the stern of the disabled vessel, make a starboard turn bringing the starboard to the distressed craft's port side, continue forward and around the bow, which will put the rescue vessel's bow into the wind and in position to begin the tow. By passing around the distressed vessel in this manner several opportunities will occur for the crew to pass the line to the distressed vessel.

The same basic approach and maneuver may be used when it becomes necessary to put someone aboard an unattended drifting vessel.

In situations where it is impracticable to pass a line by heaving, such as heavy seas, wind, or a stranded vessel in water too shallow for the rescue craft, it may be possible to float the line to the disabled vessel.

When a dinghy is employed to run the line, most of the coil must be carried in the boat and paid out over the stern because the drag of a large line paid out from the rescue vessel to the dinghy will make headway impossible. The rescue vessel should be anchored upwind



in line with the distressed vessel when passing a line by flotation or small boat.

A crew member should always tend the line carefully so as not to foul the propeller.

MAN OVER BOARD RESCUE TECHNIQUES

Getting someone out of the water is the most important and one of the most common types of rescue. It is the *first* objective in all rescue operations.

Always approach from down wind, do not take a chance of further injuring the victim by blowing over him. A conscious person not weakened by shock or injury does not present a great problem. He can follow instructions and aid in his rescue. Get a ring buoy, cushion or vest to him right away. Do not throw these at him but near him as it could render him unconscious or cause further injury by striking him. Also throw a line. The end of the line thrown should have a loop in it so the victim can easily secure it to his body. Persons in the water become exhausted quickly in distress situations and cannot be expected to think quickly or logically due to shock. It is well to underestimate rather than over estimate the ability of a victim in a distress instance. Get a boarding ladder over, and if it does not reach below the surface of the water, make a first step for the victim, by fastening a docking line with an eye splice to a cleat. Be careful when assisting a victim in rough weather, being sure to prevent the boat from striking him on the head as it rolls, which may knock him unconscious or add to his injury.

Never bring a victim aboard the stern end of a vessel with the engine running.

If the person in the water is exhausted or unconscious it is a more difficult task. This requires that at least one of the crew must go overboard to the victim. The crew member must wear a life jacket and carry the end of a life line along with him, the other end made fast to the vessel. He must get the victim's head above water, secure the life line around the victim's chest under the arms, and maneuver him to the vessel.

When the swimmer and survivor are alongside the boat, the swimmer should place a lifting line with a hoisting sling or bowline (loop) under the armpits and across the back of the survivor. The survivor is then hoisted aboard with the front of his body facing the boat. The swimmer remains in the water to assist. The survivor is brought aboard facing inboard to avoid serious spinal injuries that might otherwise result from pivoting on his back when being pulled over the edge of the main deck or boat's gunwale.

If the boarding ladder reaches beneath the surface, the crew member in the water may be able to bring the victim out of the water, by means of the over-the-shoulder carry method, to a position where those on board can complete the task. Rescue of an unconscious victim is never an easy operation.

Once a victim is on board begin First Aid at once. Regardless of the victims condition, always treat for shock.

RIGHTING CAPSIZED CRAFT

As sail fleets become popular, more and more Auxiliarists will become involved in a sailboat rescue operation, especially on Sailboat Race Patrols. There is a right way and a wrong way to assist sailcraft; and co-operation between the rescuers and rescuees can make for a smoother operation, avoiding damage and possible injury to those in the water.

Whenever a sailboat flips, rescue vessels head for the vicinity, but sometimes more damage is done by the rescue operation than in the capsizing. An inexperienced rescuer can be a trial and even a danger to sailors, but a rescuer is, after all, a necessity.

When approaching a capsized sailboat, it is important to remember the amount of damage that can be caused by a motorboat's wake. As for the approach itself, there are two schools of thought: approach from upwind and approach from downwind. The upwind approach has the advantage of keeping the rescue vessel clear of most of the floating debris. The downwind approach will aid in keeping the motorboat, with its higher freeboard, from drifting down on the sailboat, trapping either crewmen or gear between the vessels.

The final decision as to the approach must be made only after studying the conditions on hand. There can be no textbook answer that will cover every eventuality.

As you approach, instruct the sailors to stay with the sailboat and don PFD's. Check right away whether all hands are OK, or whether anyone is in trouble and needs to be picked up immediately. Remember the effects of water temperature on persons in the water; in cold weather do not let swimmers remain in the water long. They may suffer sudden and complete loss of muscular power.

If possible the sails should be removed from the capsized boat, and gear collected on the rescue boat; pick up all loose floating gear. Righting and towing procedures vary greatly depending on the type of sailboat. Do not tow a boat while still capsized. She will be unmanageable and damage will almost certainly result.

One method proven successful in righting sailcraft, after a bow line has been secured, is to have the crew right the vessel in the water by standing on the keel or center board forcing it down. It may be necessary to further assist the crew in this operation. If this should be required, secure a line to the mast and pull it to the stern of the rescue boat. Lift the mast, remove the line, and continue to raise the mast manually, righting the craft. If this is not successful, it may become necessary to remove the mast in order to right the vessel.

Once righted, have the crew, still in the water, go aft to the vessel's stern. Snub the vessel's bow to the rescue vessel's stern, with her bow held high, start towing directly to windward. Crew weight aft and balanced with bow up will help drain a swamped boat and keep her upright while being towed. The tiller of the sailboat should be tended by the crew or secured amidships. Lengthen the tow line in order that the bow will ride up on towing vessel's wake. This will also assist the draining. A little speed helps drain cockpits but too much will cause undue strain and problems.

After the cockpit is sufficiently drained and seas permit, bring the sailcraft along side the SAR vessel and have the crew bail out the remaining water.

TECHNIQUES OF TOWING

This is probably the most common type of assist made by Auxiliarist and boatmen in general and also the most controversial. Conditions of the sea and weather have a great bearing on towing techniques as does the type of craft being towed.

Before any towing operation starts the crew members of the rescue vessel and the persons on the distressed vessel should don PFD's. This is necessary for the safety of anyone working topside and in the event that the towed vessel founders.

Pleasure craft are not well suited for towing because stern cleats are usually aft of the propeller and rudder, causing a towing strain on the stern and making it more difficult to respond to rudder. The general theory for towing is to make the line fast on the rescue vessel at some point forward of the rudder.

The best method for making fast a tow line on a rescue vessel of the pleasure craft design is the use of a bridle running from bitts forward of the rudder and wheel. Such bridles should be wrapped to prevent chafing, and made of nylon or manila line. The rule-of-thumb for the length of a towing bridal is three times the width of the towing vessel's transom.

A long tow line should be used and should never be made fast in such a manner that would prevent it from being cast off, cut, or changed on an instants notice. When the tow line is secured, take up the slack slowly, go forward into the wind slowly or have someone play out the line by hand. A sudden burst of speed causing a surge or yank on the line can damage either or both vessels.

Nylon line makes a good tow line not only because of its strength but because of its ability to spring or stretch, easing shocks. Long tow lines tend to ease towing because the line sag relieves sudden strains. In rough seas it is advisable to use a long tow even on light craft.

The exception to this usual rule of a long tow is in rough weather when a very large vessel is towing a small vessel, and a short tow line will keep her close in the towing vessel's wake and out of the heavy seas.

When practicable the tow line should allow both the towing and towed vessels to be on a wave crest or in the

trough at the same time. This is sometimes called keeping the boats "in step."

After arriving in quiet waters and near a destination, take in on the scope of the tow line to allow better handling at close quarters.

Remember, always swing as wide as possible around buoys, boats or channel turns, allowing for towed vessel to follow.

Tow lengths for a small outboard may be accomplished with lines no longer than 25 feet but for powerboats and sailboats have *at least* 100 feet or more of scope. Remember a tow line is always a potential danger to anyone near should it break and whip into the vessel, particularly nylon which has considerable stretch under a strain. This applies to both the rescue and disabled vessels, so keep a constant vigil on the line and keep clear from directly behind it.

A member of the crew is always assigned to watch the tow line and towed vessel.

The tow may be taken alongside for maneuvering in close quarters, such as docking.

The towing of a vessel is usually always the end of the mission so use good judgment and exercise all precautions to prevent further difficulties. Tow at a speed that allows control and avoid excessive strain.

TECHNIQUES OF REFLOATING CRAFT AGROUND

It sounds like a very simple operation to send a line to a disabled vessel; approach with rescue vessel, bow on, pass the line and move out. Some assists, but not many, are just this simple. However, be concerned with those situations which, because the conditions of one or more factors, complicate the manuever.

All that is about to be discussed is with the assumption that the distressed vessel is grounded but not holed or strained open. This should be ascertained in all rescues of this nature immediately upon arrival. Should either of the conditions exist it may be better to let the vessel remain where she is and place anchors to prevent further damage. If damage is severe, it may be necessary to also take an anchor ashore to hold her or pull still further in until temporary repairs can be made.

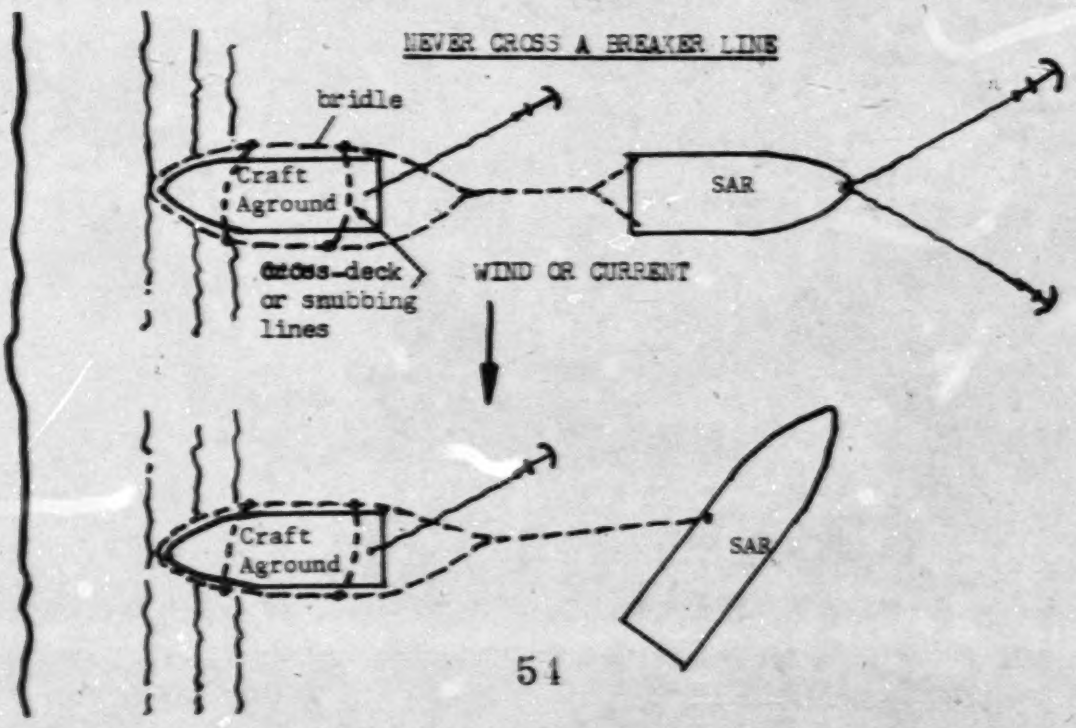
Wind, current and water depth are the conditions determining action in assisting stranded craft.

When conditions are such that close approach is inadvisable, anchor with one or two anchors and send in a line.

If the wind or current, or both, are broadside to the direction of the pull, the assisting vessel may stay anchored even while pulling the stranded vessel to deeper water, as she may lose maneuverability and go aground broadside.

When the assist is to be accomplished with the rescue vessel under way, the tow line should be made fast well forward on the rescue vessel so that maneuverability is maintained while under the hauling stress.

Severe strains are exerted, particularly on the stranded vessel, therefore, a bridle around the entire hull



with cross deck or snubbing lines should be used. This would also apply to the rescue vessel, if there is any doubt as to its ability to withstand this concentrated strain. Personnel on both boats should stand clear from the towline to avoid injury should it part under strain.

The type of bottom on which the vessel is aground must be a further consideration. If the bottom is rocky and the hull is dragged, more damage is done than by the grounding. Muddy bottoms may cause suction and while attempting to pull the grounded vessel, it may be necessary to have the persons on board her rock the vessel from side to side breaking the suction. Sand bottom will not create suction, but will build up quickly on the seaward side of a grounded vessel.

In some instances in tidal waters when the stranded vessel will not come free and is not in any immediate danger, it may be advisable when on a low tide to wait it out for a few hours. Be certain to secure the necessary anchors to prevent further distress when this situation is requested or recommended.

Assisting a grounded vessel is a dangerous operation and it is of paramount importance that the rescue vessel does not also become a disabled craft. Exert caution in approach to the vessel and never sacrifice ability to maneuver.

TECHNIQUE OF APPROACHING A BURNING VESSEL

Approaching a burning vessel should never be undertaken by an Auxiliarist unless the fire is a small one without danger of explosion, and only then when it is to save lives that could be rescued from the water, or to prevent the burning craft from drifting into anchored or docked boats nearby.

The average Auxiliary Search and Rescue Vessel is not equipped to cope with fire, which requires specialized fire fighting equipment and training.

When it is absolutely necessary to take an injured or unconscious person from a boat afire, make the approach and departure *without a second's loss.*

Break out all fire fighting equipment and have it ready for protection to the SAR vessel.

The approach to the burning vessel should be from upwind to keep clear of smoke flame or sparks. String fenders, extra life jackets, cushions or whatever padding may be on board, on a line and hang same over the bow to serve as a bow fender, which will be the contact point with the side of the vessel afire. Do not exert pressure or push the distressed vessel as such may result in bringing the vessel around and broadside to the rescue craft. Accomplish the mission with all possible speed and get away fast. Leave upwind from the fire.

Persons on vessels that are burning badly should be instructed to put on life jackets and jump overboard, on windward side, and be taken on board the rescue vessel from the water. Conditions which would trap the victims against the boat would alter the departure side of the burning vessel.

Another service which Auxiliarist may perform is the Safety Patrol around a burning vessel, keeping curious and untrained boatmen from cruising within the danger area of the fire and anticipated explosion. Saving life and the prevention of further distress is the mission.

HELICOPTER EVACUATION

Helicopter evacuation is a hazardous operation to the distressed person and to the flight crew, and should only be attempted in a matter of life or death.

When requesting helicopter evacuation assistance:

(a) Give the accurate position, time, speed, course, weather conditions, sea conditions, wind direction and velocity, type of vessel and voice frequency for the distressed vessel.

(b) If not already provided, give complete medical information, including whether or not the distressed person is ambulatory.

(c) If the vessel is beyond helicopter range, advise diversion intentions so that a rendezvous point may be selected.

(d) If there are changes to any items reported earlier, advise the rescue agency immediately. Should the distressed person die before the arrival of the helicopter, be sure to advise those assisting. Remember the operation involves risking the flight crews lives as well.

(e) Provide continuous radio guard on specified voice frequency, if possible.

(f) Select and clear the most suitable hoist area, preferably aft on the vessel. This must include the securing of loose gear. Trice up running rigging and booms. If hoist is aft, lower the flag staff.

(g) If the hoist is to take place at night, light the pickup areas as well as possible. Be sure to not shine any lights on the helicopter, so that the pilot is not blinded. If there are any obstructions in the vicinity, put a light on them so the pilot will be aware of their positions.

(h) Point search lights vertically to aid the flight crew in locating the vessel and turn them off when the helicopter is on the scene.

(i) Be sure to advise the helicopter of the location of the pickup area on the vessel before the helicopter arrives, so the pilot may make his approach to aft, amidships or forward, as required.

(j) Remember, there will be a high noise level under the helicopter, so voice communications on deck will be almost impossible. Arrange a set of hand signals among the crew who will assist. Keep personnel not involved clear of the hoist area.

(k) If possible, have the person moved to a position as close to the hoist areas as his condition will permit–TIME IS IMPORTANT.

(l) Normally, if a litter (stretcher) is required, it will be necessary to move the person to the special litter which will be lowered by the helicopter. Be prepared to do this as quickly as possible. Be sure the patient is strapped in, face up, and with a life jacket on (if his condition will permit).

(m) Be sure that the person is tagged to indicate what medication, if any, was administered to him, and when it was administered.

(n) Have the person's medical record and necessary papers in an envelope or package ready for transfer with him if possible.

(o) Again, if his condition permits, be sure he is wearing a life jacket.

(p) Change the vessel's course to permit the ship to ride as easily as possible with the wind on the bow, preferable on the port bow.

(q) Reduce speed to ease ship's motion but maintain steerageway.

(r) If there is no radio contact with the helicopter, when ready for the hoist, signal the helicopter in with a "come on" with hand, or at night by flashlight signals.

(s) Allow basket or stretcher to touch deck or water prior to handling to avoid static shock.

(t) If a trail line is dropped by the helicopter, guide the basket or stretcher to the deck with the line; keep the line free at all times.

(u) Place the person in basket, sitting with his hands clear of the sides, or in the litter. Signal the helicopter hoist operator when ready for the hoist. The person should signal by a nodding of the head if he is able.

(v) If it is necessary to take the litter away from the hoist point, unhook the hoist cable and keep it free for the helicopter to haul in. DO NOT SECURE CABLE TO THE VESSEL OR ATTEMPT TO MOVE STRETCHER WITHOUT UNHOOKING.

(w) When the person is strapped into the stretcher, signal the helicopter to lower the cable. hook up and signal the hoist operator when the patient is ready to hoist. Steady the stretcher so it will not swing or turn.

(x) If a trail line is attached to the basket or stretcher, use it to steady the person as he is hoisted. Keep feet clear of the line.

RULES FOR AVIATION SEAMANSHIP

The crew of the rescue vessel should keep on the alert for the aircraft pilot's orders, directions and suggestions when approaching a distressed aircraft.

Approach drifting planes from the windward and moored planes from leeward, to prevent the wind from driving the rescue vessel against the aircraft or the aircraft against the rescue vessel. Unless moored, the aircraft, being higher and lighter, will drift faster than a vessel.

Remember that aircraft are fragile. Approach slowly, keep fenders out and fend off aircraft by hand.

Keep the vessel out from beneath the aircraft's wings or fuselage. A swell may cause a damaging collision.

Do not approach an aircraft while its propellers are turning. A spinning propeller is a deadly weapon.

The vessel's backing ability should be checked before approaching an aircraft. Check reversing ability for the existing conditions of wind and sea.

Tow an aircraft stern first, and only when necessary, and only for short distances. Seaplanes or amphibious aircraft which are afloat should normally be towed bow first.

Tow an aircraft on about the second wave of the towing vessel's wake. Go slowly, especially when moving to windward. Do not let the aircraft bounce or yaw.

Remember that speed is the most important factor in rescuing the crew of a crashed aircraft.

AIRCRAFT RESCUE OPERATIONS

Saving life is the rescue vessel's most important task. Nothing should deter this mission.

If the aircraft is afire, throw life ring buoys with attached line to the flight crew and hand pull them to safety. Go as close to the burning craft as safety permits. Watch for gasoline explosions. No one will be saved if the rescue boat is also destroyed.

Burning aircraft, like burning vessels, should be approached from windward to avoid sparks, smoke and heat generated by the burning fuel and oil. Rescue work must proceed with great speed. Land aircraft sink very rapidly, as do seaplanes, if their watertight compartments or pontoons are ruptured.

Once the crew is rescued the mission is complete; leave salvage operations to those more experienced and qualified in this phase of operations. If necessary, stay on scene to keep curious boaters out of the area of danger.

DAMAGE CONTROL

Damage control is anything that reduces the harmful effects of any damage to a vessel, the primary purpose being to keep the vessel afloat or in condition to reach a beach or port.

The main reasons for damage control considerations are:

1. To take all necessary action before damage occurs. This means making vessel watertight and

gas-tight in those parts which present possible hazards, as well as keeping necessary emergency equipment aboard.

2. To control damage caused by flooding, collision, grounding, explosion and fire.

3. To provide emergency temporary repairs or restore services after malfunction or damage occurs.

Auxiliarists, while primarily concerned with SAVING LIVES, may become involved with situations where knowledge and advance preparation may save property. Damage control shall never be attempted when there is risk of injury or peril to life.

Repair of holes in the hull and flooding underway are strictly emergency measures. Whatever material is at hand must be used. The important thing is to keep the vessel afloat.

(a) Small holes, broken lines, lost shafts and such may be temporarily repaired by driving wooden plugs or wedges into the opening. Plugs wrapped in cloth also make good seals. Care must be taken before driving plugs and wedges so as not to enlarge the crack, split the hose or further the damage. Plugs of assorted sizes should be carried on board for these emergencies.

(b) Large hull holes through which water is pouring are difficult to control. Inside patching or plugging may be accomplished with pillows, mattresses and blankets backed up with floor boards, table tops, deck chairs or other solid items available on scene. Inside patches are preferred since outside patches are difficult to tend and may be knocked off by sea action. There are many types of patches and shorings which may be used in the emergency. One must be calm, alert and work fast with the tools at hand if the vessel is to be kept afloat.

(c) Outside hull patches are usually made in calm or shallow water when inside patches are ineffective, and then only when the overboard action presents no danger to the person or persons making the repairs. Canvas, rain curtains or covers, industrial plastic (carried especially for such purposes) plywood or masonite may be used to cover the hole. To secure the materials above the water line presents no major problem in nailing on wooden hulls. For holes below the waterline nailing is difficult and a staple gun should be carried for this purpose. Holes in plastic or fiberglass hulls present a special problem in securing the patch. A large section of sponge rubber (such as used for under carpet padding) should be carried to sandwich between the hull and patch to prevent slipping. The rubber or other such material and covering patch (of solid material) are then secured in place with lines around the hull such as one bandages a wound.

Sailcraft with holes in the hull can work a spinnaker or large sail beneath and around the hull, forming a bag. Water pressure will keep the sail tight over the hole once it is secured around the hull.

Flooding water can seldom be controlled by ordinary bilge pumps alone. When special pumps are not immediately available, and the damaged vessel's motor is operating, close off the through-hull valve on the water intake of the cooling system and sever the hose, thus using the engines water pump to bail the vessel.

FIRE PREVENTION

No one wins against a fire. It may be fought efficiently and well, the damage may be minimized, the fighters work hard; but the fact remains the property is lost, some lives may even be lost or injuries received. Therefore, the best way to combat fires is to prevent them.

The three ingredients required for fire are: FUEL, HEAT and OXYGEN. These ingredients are like the three sides of a triangle. Eliminate any one side of this triangle and extinguish the fire. Eliminating fuel on a small craft with built in tanks is impossible. Heat, the second side of the triangle, may be removed through the use of water, water sprays or by ventilating to the outside. Oxygen, the third side of the triangle, may be removed by introducing another gas into the fire area and so diluting the atmosphere that it will no longer support combustion. Foam may also be used, which creates a blanket over the fire zone preventing fresh oxygen supplies from reaching it.

It is important to understand the different classes of fires since they must be combated by different means. Water is ideal for some fires, but can ruin electrical equipment or cause short-circuits and, if used on gasoline, may make the fire worse. Fires are classified into the following three general types:

1. *Class A fires*: Fires in ordinary combustible materials (such as bedding, clothing, canvas, rope and wood) where the cooling effect of water is of first importance in extinguishment. The chief characteristics of Class A combustibles is the embers or ashes remaining after burning. Material of this type must be cooled throughout the entire mass before extinguishment is complete.
2. *Class B fires*: Fires of inflammable liquids (such as gasoline, oil, grease, paint and turpentine). Materials of this type burn at the surface where the vapors are given off. A smothering or blanketing of the burning surface is best for extinguishment. Foam, CO_2, steam, certain dry chemicals, and a combined use of fog with foam are effective in smothering this type of fire.
3. *Class C fires*: Fires in electrical equipment where use of a "non-conducting" extinguishing

agent is of first importance. In most electrical fires it is necessary to de-energize the circuits before progress can be made. Carbon dioxide (CO_2) is a non-conductor of electricity and will not damage electrical equipment.

CLASSIFICATION OF FIRE EXTINGUISHERS

The following chart gives the classes of fires upon which the extinguishers are most effective, the range of the extinguisher, and whether the extinguisher is safe for use on live electrical equipment.

Type of Extinguisher	Most Effective	Range	Safe on Electrical Fires
Soda-Acid	Class A	Approximately 35 feet	No
CO_2 Gas Cartridge Water	Class A	Approximately 35 feet	No
Foam	Class B	Approximately 35 feet	No
CO_2	Class B-C	2 to 8 feet according to size	Yes
Dry Chemical	Class B-C	20 to 25 feet according to size	Yes

SCUBA DISTRESS INCIDENTS

The Coast Guard has no statutory responsibility for providing recompression treatment equipment or for managing decompression sickness cases in SAR actions involving SCUBA diving accidents. However, Coast Guard assistance may be requested by persons seeking emergency treatment facilities.

Coast Guard Auxiliary assistance shall be limited to arranging or providing transportation and advising requesting persons where the nearest recompression facility is located and notifying the Coast Guard of the need for the nearest chamber in order that chamber operators can be prepared to receive the patient.

IN NO EVENT SHOULD COAST GUARD AUXILIARY PERSONNEL ATTEMPT TO DIAGNOSE DECOMPRESSION SICKNESS OR ADVISE USE OF RECOMPRESSION EQUIPMENT. RECOMPRESSION TREATMENT CAN BE FATAL IF ADMINISTERED WHEN NOT REQUIRED.

Each Rescue Coordination Center has the necessary information on all recompression chambers located within its district.

The following medical information is necessary in these cases:

1. Depth of the water in which the victim has been diving.
2. Rate of ascent from what depth.
3. Amount of time down on the dive.
4. Amount of time down and depth on any preceding dives made during the past 24 hours.
5. Location and nature of first symptom (i.e., cramp in calf of left leg, pain in back of neck) and same information on any succeeding symptoms.

SUMMARY

The information contained in this chapter is not intended to train repairmen or fire fighters. It *is* intended to educate members of the Auxiliary *not* to undertake any action which may in any way endanger human lives or property, and to properly evaluate those situations which may confront any boatman at any time.

CHAPTER XI

SAR ADMINISTRATION

Search and Rescue administration in the Auxiliary consists of (1) processing SAR information promptly and accurately, (2) effectively managing the training and preparedness of personnel and facilities and (3) maintaining close contact with the Coast Guard and civilian rescue agencies.

PROCESSING SAR INFORMATION

Every Auxiliarist involved in patrol or SAR activity should know how to properly complete a CASUALTY/ ASSISTANCE REPORT form (CG-3937) as shown in Figure 3. Applicable items in each lettered block are to be checked or circled and each numbered blank is to be filled in with appropriate information. After completing the form, the Auxiliarist forwards it as directed by the District instructions.

Auxiliary Flotilla and Division operations officers should establish convenient SAR incident notification and report forms, to speed SAR information from Coast Guard to Auxiliarist and vice versa. An example of a possible format is shown in Figure 4. Reporting results after a mission to the nearest Coast Guard operational unit is a must.

It should also be noted that for the Auxiliarist or his flotilla to be credited for an assist, the report of assistance must be received by the District Director of Auxiliary.

MANAGING PERSONNEL AND FACILITIES

The effective management of SAR personnel and facilities begins with training of the personnel. The successful completion of the Auxiliary Communications Specialty Course and this Search and Rescue Specialty Course are fundamental to this objective. SAR drills serve to keep SAR personnel and facilities in preparedness. SAR facilities should be facilities inspected by the Flotilla or Division Operations Officer in order that he may have direct cognizance of the vessel capability and seaworthiness for various missions.

A roster of SAR personnel and facilities should be maintained by the flotilla and division operations officer. A copy of the roster should also be provided to the local Coast Guard unit. However, notification to a particular Auxiliary facility for a SAR mission should usually be made through an Auxiliary operations officer. Notification procedures should be reviewed with the local Coast Guard unit commander and watch personnel.

Flotilla or Division Operations Officers are also responsible for the scheduling of personnel to man the Auxiliary SAR Mission Control, if such a facility is maintained.

MAINTAINING CONTACT WITH AGENCIES

Auxiliary flotillas engaged in frequent SAR work should maintain continuing personal contact with representatives of police, fire and sheriff rescue units, ambulance services, conservation units, SCUBA clubs, and similar organizations, and should maintain a liaison file of telephone numbers. Dockmasters, bridge and lock tenders, marina operators, fish camps and light-keepers are also persons whose telephone contact should be listed.

Civil Air Patrol and aero clubs can be of great assistance in SAR and should be included in any listings. No liaison file has ever had too much information in it.

SUPPLEMENTARY INFORMATION

Since the cause of engine equipment failures cannot be determined by superficial inspection at the time of an incident, the form CG-4880 has been designed to collect this information after repairs have determined the problem areas. This information is of great value in the establishment of safety standards.

CG-4880 is franked and pre-addressed and need only be handed to the boatman by the assisting Auxiliarist. A copy of the form is shown in figure 5.

U.S. COAST GUARD AUXILIARY - CASUALTY/ASSISTANCE REPORT

(Circle or check all applicable items, fill in blanks, and send as directed to the Director of Auxiliary or Cognizant CG Unit.)

DEPAR

A. ASSISTING AUXILIARISTS

1. MEMBER NUMBER

2. PRINT NAME *(Last, First, M.I.) (List other auxiliarists assisting on reverse side.)*

B. CRAFT ASSISTED

1. HIN *(Or manufacturer name, if not available)*
2. REGISTRATION NO.
3. ENGINE SERIAL NO. *(Outboard only)*
4. HORSEPOWER
5. MAKE OF ENGINE *(Outboard only)*
6. LENGTH IN FEET
7. CURRENT CME DECAL? ☐ YES ☐ NO

C. DATE/TIME OF ASSIST

1. DATE *(MO/D/YR)*
2. TIME ON SCENE AM PM
3. HOURS ON ASSIST

D. WEATHER CONDITIONS

1. VISIBILITY *(Mi)*
2. SEASTATE *(Ft)*
3. WIND *(Knots)*

E. LOCATION OF ASSIST

1. CG DISTRICT
2. COUNTY *(Nearest)*
3. STATE *(Nearest)*
4. BODY OF WATER

F. CAUSE OF CASUALTY

1. ENGINE FAILURE: CG-4880 ISSUED? ☐ YES ☐ NO
2. EQUIPMENT FAILURE CG-4880 ISSUED? ☐ YES ☐ NO
3. HULL FAILURE:
4. OUT OF FUEL
5. WEATHER
6. OVERLOADING
7. IMPROPER LOADING
8. OPERATOR FAULT *(Specify)*
9. OTHER *(Specify)*

NATURE OF CASUALTY

G. CRAFT

01. LOSS OF POWER
02. FLOODING
03. GROUNDING
04. PLANE CRASH
05. CAPSIZING
06. SINKING
07. DISAPPEARANCE
08. FIRE/EXPLOSION
    ☐ A. FUEL
    ☐ B. ELECTR.
09. COLLISION WITH VESSEL
10. COLLISION *(Other)*
    ☐ A. FIXED OBJECT
    ☐ B. FLOATING OBJECT
11. NONE
12. OTHER *(Specify)*

1. DIS
2. FAL
3. FAL
4. BUR
5. STR
6. CRU
7. NON
8. OTH

K. W

I. TYPE OF ASSIST

1. TOW
2. REPAIR
3. REFLOAT
4. FUEL
5. MEDICAL
6. RESCUE
7. OTHER *(Specify)*

J. ASSIST GIVEN TO

01. ROWBOAT
02. AIRCRAFT
03. SAIL ONLY
04. AUXILIARY SAIL
05. HOUSEBOAT
06. OPEN MOTORBOAT
07. CABIN MOTORBOAT
08. CANOE/KAYAK
09. PERSONNEL ONLY
10. OTHER *(Specify)*

1. ON
2. ON
3. ON
4. ON

L. WAS ☐

M. DID CG

N. LIVES/PROPERTY

1. NO. LIVES SAVED *(Give names in remarks)* _____
2. NO. OF PERSONS OTHERWISE ASSISTED _____
3. NO. PERSONS DROWNED *(Give names in remarks)* _____
4. NO. OF LIVES LOST - OTHER THAN DROWNING _____
5. NO. PERSONS KNOWN TO REQUIRE H
6. VALUE OF PROPERTY SAVED *(Estima*
7. VALUE OF PROPERTY ASSISTED *(Est*
8. PROPERTY DAMAGE ☐ OVER $100

Previous editions are obsolete

(Over)

60

FIGURE 3

AUXILIARISTS

, M.I.) (List other auxilia-
e side.)

ASSISTED
me, if not available)

3. ENGINE SERIAL NO. (Outboard only)

5. MAKE OF ENGINE (Outboard only)

7. CURRENT CME DECAL?
☐ YES ☐ NO

E OF ASSIST

ON SCENE | 3. HOURS ON ASSIST
PM

CONDITIONS

TATE (Ft) | 3. WIND (Knots)

N OF ASSIST

. COUNTY (Nearest)

. BODY OF WATER

ote

U.S. COAST GUARD AUXILIARY - CASUALTY/ASSISTANCE REPORT

(Circle or check all applicable items, fill in blanks, and send as directed to the Director of Auxiliary or Cognizant CG Unit.)

DEPARTMENT OF TRANSPORTATION
U.S. COAST GUARD
CG 3937 (REV. 1-73)

F. CAUSE OF CASUALTY

1. ENGINE FAILURE:
   CG-4880 ISSUED? ☐ YES ☐ NO
2. EQUIPMENT FAILURE
   CG-4880 ISSUED? ☐ YES ☐ NO
3. HULL FAILURE:
4. OUT OF FUEL
5. WEATHER
6. OVERLOADING
7. IMPROPER LOADING
8. OPERATOR FAULT *(Specify)*
9. OTHER *(Specify)*

NATURE OF CASUALTY

G. CRAFT

01. LOSS OF POWER
02. FLOODING
03. GROUNDING
04. PLANE CRASH
05. CAPSIZING
06. SINKING
07. DISAPPEARANCE
08. FIRE/EXPLOSION
   ☐ A. FUEL
   ☐ B. ELECTR.
09. COLLISION WITH VESSEL
10. COLLISION *(Other)*
   ☐ A. FIXED OBJECT
   ☐ B. FLOATING OBJECT
11. NONE
12. OTHER *(Specify)*

H. PERSONNEL

1. DISAPPEARANCE
2. FALL OVERBOARD
3. FALL IN BOAT
4. BURNS/SCALDS
5. STRUCK BY BOAT/PROPELLER
6. CRUSHED/PINCHED
7. NONE
8. OTHER *(Specify)*

I. TYPE OF ASSIST

1. TOW
2. REPAIR
3. REFLOAT
4. FUEL
5. MEDICAL
6. RESCUE
7. OTHER *(Specify)*

J. ASSIST GIVEN TO

01. ROWBOAT
02. AIRCRAFT
03. SAIL ONLY
04. AUXILIARY SAIL
05. HOUSEBOAT
06. OPEN MOTORBOAT
07. CABIN MOTORBOAT
08. CANOE/KAYAK
09. PERSONNEL ONLY
10. OTHER *(Specify)*

K. WHEN ASSIST OCCURRED, WERE YOU

1. ON REGATTA PATROL
2. ON SAFETY PATROL
3. ON CG ASSIST MISSION
4. ON RECREATIONAL OUTING

L. WAS THE ASSIST ON CG ORDERS?
☐ YES ☐ NO

M. DID YOU REPORT ASSIST TO COG. CG UNIT? ☐ YES ☐ NO

N. LIVES/PROPERTY

1. NO. LIVES SAVED *(Give names in remarks)* _____
2. NO. OF PERSONS OTHERWISE ASSISTED _____
3. NO. PERSONS DROWNED *(Give names in remarks)* _____
4. NO. OF LIVES LOST - OTHER THAN DROWNING _____
5. NO. PERSONS KNOWN TO REQUIRE HOSPITALIZATION _____
6. VALUE OF PROPERTY SAVED *(Estimate)* $ _____
7. VALUE OF PROPERTY ASSISTED *(Estimate)* $ _____
8. PROPERTY DAMAGE ☐ OVER $100 ☐ UNDER $100 ☐ NONE

(Over)

61

FIGURE 3

USCG AUX – SAR LOG

NOTIFICATION DATA

NOTIFIED: DATE_____ TIME_____ BY_____ PHONE NO._____
OTHER AGENCIES NOTIFIED_____ TIME_____ PHONE NO._____
COMMERCIAL ASSISTANCE NOTIFIED_____ TIME_____ PHONE NO._____
RADIO COMMUNICATIONS TO BE CONDUCTED ON_____
FAMILY OR FRIEND TO BE KEPT INFORMED_____ PHONE NO._____

DISTRESSED CRAFT DATA

VESSEL NAME_____ REG NO._____ TYPE_____
COLOR_____ LENGTH_____ BEAM_____ DRAFT_____
LAST POSITION GIVEN_____ TIME GIVEN_____
DOCK OR RAMP DEPARTED FROM_____ DESTINATION_____
NATURE OF DISTRESS_____
_____
TOW REQUIRED_____ ADRIFT_____ ANCHORED_____
NUMBER OF PERSONS ABOARD_____ NUMBER INJURED_____
OPERATOR'S NAME_____ PHONE_____
ADDRESS_____
EQUIPMENT ABOARD: MARINE RADIO_____ CB RADIO_____ FLARES_____
FLASHLIGHT_____ CLOTHING_____
AUTO DESCRIPTION: YEAR/MAKE_____ COLOR_____
BOAT TRAILER DESCRIPTION_____

SEARCH CRAFT DATA

CAPT._____ FACILITY_____
DEPARTED FROM_____ TIME_____ ETA_____
TIME ON DISTRESS SCENE_____ POSITION_____
DISTANCE FROM REPORTED POSITION OF DISTRESS_____
NATURE OF DISTRESS FOUND_____
_____
CAUSE OF DISTRESS_____
ASSISTANCE RENDERED_____
WEATHER: VIS_____ WIND_____ WAVES_____ TIME SECURED_____

Figure 4.

Form Appro

DEPARTMENT OF TRANSPORTATION U.S. COAST GUARD CG-4880 (10-72)	ENGINE/EQUIPMENT FAILURE NOTIFICATION	1. BOA

YOU HAVE JUST BEEN ASSISTED BY THE U.S. COAST GUARD AUXILIARY.

The Auxiliary is a volunteer, civilian organization working with the U.S. Coast Guard to preserve your safety on the waterways. You can assist in this effort by completing and mailing this card as soon as the cause for the breakdown of your boat has been determined. The information you provide will be used by the Coast Guard to recommend any necessary boat/engine building standards, and will result in a safer, more reliable and economical boat for your recreational pleasure.

NOTE: If you have any doubt about the safety of your boat, please write to the address on reverse side.

2. MAK
3. MOD
5. MAK
6. SER

CAUSE OF MALFUNCTION *("X" applicable items)*

7. FUEL SYSTEM	8. ELECTRICAL	9. LUBRICATION	10. DRIVE UNIT
1. FUEL PUMP	1. FAULTY WIRING	1. OIL PUMP	1. PART FAILURE
2. INJECTION PUMP	2. ALTERNATOR	2. OIL FILTER	2. CLUTCH
3. CARBURETOR/INJECTORS	3. GENERATOR	3. LEAK	
4. LEAKY LINES/FITTINGS	4. VOLTAGE REG.	12. CONTROLS	13. COOLING SYSTEM
5. FILTERS	5. SPARKPLUGS	1. SHIFT	1. WATER PUMP
6. VENTILATION	6. DISTRIBUTOR	2. SPEED	2. LEAK
	7. BATTERY	3. STEERING	

15. MAY WE CONTACT YOU IF ADDITIONAL INFORMATION IS NEEDED? ☐ YES ☐ NO		16. AREA CODE AND TE
17. PRINT NAME OF INDIVIDUAL COMPLETING FORM	18. DATE	19. HULL IDENTIFICATION NO. *(If available*

60

63

FIGURE 5

Form Approved OMB No. 04R-3084

DEPARTMENT OF TRANSPORTATION
U.S. COAST GUARD
CG-4880 (10-72)

ENGINE/EQUIPMENT FAILURE NOTIFICATION

1. BOAT REGISTRATION NO.

YOU HAVE JUST BEEN ASSISTED BY THE U.S. COAST GUARD AUXILIARY.

The Auxiliary is a volunteer, civilian organization working with the U.S. Coast Guard to preserve your safety on the waterways. You can assist in this effort by completing and mailing this card as soon as the cause for the breakdown of your boat has been determined. The information you provide will be used by the Coast Guard to recommend any necessary boat/engine building standards, and will result in a safer, more reliable and economical boat for your recreational pleasure.

NOTE: If you have any doubt about the safety of your boat, please write to the address on reverse side.

2. MAKE OF BOAT

3. MODEL & YR BUILT | 4. LENGTH

5. MAKE OF ENGINE

6. SERIAL NO. OF ENG. | 7. HP

CAUSE OF MALFUNCTION *("X" applicable items)*

7. FUEL SYSTEM	8. ELECTRICAL	9. LUBRICATION	10. DRIVE UNIT	11. TRANSMISSION
1. FUEL PUMP	1. FAULTY WIRING	1. OIL PUMP	1. PART FAILURE	1. LACK OF FLUID
2. INJECTION PUMP	2. ALTERNATOR	2. OIL FILTER	2. CLUTCH	2. PART FAILURE
3. CARBURETOR/INJECTORS	3. GENERATOR	3. LEAK		3. CLUTCH
4. LEAKY LINES/FITTINGS	4. VOLTAGE REG.	12. CONTROLS	13. COOLING SYSTEM	14. OTHER *(Specify)*
5. FILTERS	5. SPARKPLUGS	1. SHIFT	1. WATER PUMP	
6. VENTILATION	6. DISTRIBUTOR	2. SPEED	2. LEAK	
	7. BATTERY	3. STEERING		

15. MAY WE CONTACT YOU IF ADDITIONAL INFORMATION IS NEEDED?
☐ YES ☐ NO

16. AREA CODE AND TELEPHONE NO.

17. PRINT NAME OF INDIVIDUAL COMPLETING FORM | 18. DATE | 19. HULL IDENTIFICATION NO. *(If available)*

64

FIGURE 5

CHAPTER XII

PUBLIC INFORMATION AND LEGAL ASPECTS OF SAR

GENERAL

This chapter is not intended to be a comprehensive study of Coast Guard Public Information and Legal Aspects of SAR; however it is designed to alert the Auxiliarist to potentially difficult situations he may encounter. The Auxiliarist should also be aware that these areas may require amplification by other Coast Guard directives and publications.

RELEASE OF INFORMATION TO NEWS MEDIA

Generally, Auxiliary SAR assists to the public are accomplished while under official Coast Guard orders. In such cases any news queries must be referred to the Coast Guard Group Commander who issued the orders or other Coast Guard officer or unit having operational control of the SAR case. In other cases, news release information should be limited to a statement that an accident or incident has occurred, the location of the incident, the time it was reported or occurred, and information concerning the Auxiliary's own operations and accomplishments in the assist or rescue. The rules for release of information concerning civilian casualties are complicated and may involve state, county, or municipal requirements. Therefore members of the Auxiliary shall make *no* statements to the media regarding casualties.

The value of SAR photographs for accident analysis investigations and for use with SAR articles should be kept in mind during all incidents.

ENTERING PRIVATE PROPERTY

Trespass is the entry without right onto land or private property which belongs to another. As a general rule, Auxiliary SAR personnel and land SAR units shall obtain the private owner's or occupants' permission prior to entry when engaged in a SAR incident.

However, trespass by Auxiliary SAR personnel, while rendering assistance to persons or property in *actual distress*, can be excused or justified if it is clearly required by necessity to preserve life or property. For example, it is permissable to go on another's property to prevent a drowning. In these circumstances, every effort must be made to avoid or minimize damage to the private property.

MARKING AND GUARDING WRECKAGE

The Coast Guard has no statutory requirement for the marking or guarding of wreckage. On inland waters, the vessel owner is responsible for this matter. During the execution of a SAR mission, the Coast Guard may elect however to mark wreckage in order to mark DATUM or to prevent further incident, or guard wreckage to preserve evidence for accident investigation or to provide for the security of the property involved.

ENTRY INTO CANADA

An agreement has been reached to insure adequate cooperation between the U. S. and Canada in air search and rescue operations along the common boundary. The agreement basically states that rescue facilities of Canada or the United States which are engaged in emergency Search and Rescue operations, be permitted to enter or leave either country without being subject to the immigration or customs formalities normally required by the Government of either country, *provided that* the Rescue Coordination Center involved in the search or rescue, either directly or through some person delegated by it, assumes the responsibility of informing by telephone or telegraph the immigration office and the customs office nearest to the territory over which any search or rescue is to be instituted, of the intended operation, giving details as enumerated in the agreement.

As provided in a treaty ratified in 1908 vessels and wrecking appliances, either from the United States or Canada may salve any property wrecked and may render aid and assistance to any vessels wrecked, disabled or in distress in the waters or on the shores of the other country in that portion of the St. Lawrence River through which the International Boundary line extends, and, in Lake Ontario, Lake Erie, Lake St. Clair, Lake Huron, and Lake Superior, and in the Rivers Niagara, Detroit, St. Clair and Ste. Marie, and the canals at Sault Ste. Marie, and on the shores and in the waters of the other country along Atlantic and Pacific Coasts, within a distance of thirty miles from the International Boundary on such coasts. Wrecking and salvage privileges include all necessary towing incident thereto, and nothing in Customs, Coasting or other laws or regulations of either

country shall restrict in any manner the salving or wrecking operations. Vessels from either country employed in salving in the waters of the other shall, as soon as practicable afterwards, make a full report at the nearest custom house of the country in whose waters such salving takes place.

ENTRY INTO MEXICO

As provided in a U. S.-Mexico treaty, vessels and rescue apparatus, public or private, of either country, may aid or assist vessels of their own nationality, including passengers and crew, which may be disabled or in distress on the shores or within the territorial waters of the other country within a radius of 720 nautical miles of the intersection of the International Boundary Line and the Coast of the Pacific Ocean, or within a radius of 200 nautical miles of the intersection of the International Boundary Line and the coast of the Gulf of Mexico.

The Commanding Officer, master or owner of a vessel or rescue apparatus of either country, entering or intending to enter, the territory or territorial waters of the other in order to assist a distressed vessel, shall, at the earliest practicable moment, send notice of such action or intention to the competent authorities at the port of entry of that other country nearest the scene of distress. The notice may be sent by radio or telegraphic dispatch or by any other expeditious means of communication. Such vessel or apparatus may freely proceed to, and assist, the distressed vessel unless advised by such competent authorities that adequate assistance is available, or that, for any other reason, such assistance is not considered necessary.

The master or owner of a vessel or apparatus which enters the territory or territorial waters of a country to render assistance under the authority of this treaty shall notify the competent authorities of such country upon departure from such territory or territorial waters; and private vessels, so entering, as well as private distressed vessels and the cargo, equipment, stores, crew and passengers thereof, shall be subject to the provisions of the laws in force in the country in whose territorial waters such assistance is rendered.

As used in this treaty, the word "assistance" means any act necessary or desirable to prevent the injury, arising from a marine peril, of persons or property, and the word "vessel" includes aircraft, as well as every kind of conveyance used, or capable of being used, for transportation on water.

REMOVAL OF HUMAN REMAINS

The extent of the responsibility of the Coast Guard for the recovery of bodies of drowned persons is stated in 14 USC 88 (a) (2) which, so far as is pertinent, reads "... the Coast Guard may ... care for the bodies of those who may have perished in such catastrophes." The catastrophes referred to are "marine or aircraft disasters, or floods at which the Coast Guard is present." The language of the statutes is permissive rather than mandatory, and suggests why facilities are not specifically established for this operation. In cases of drowning other than through such catastrophes, i.e., through bathers ineptness or inability at swimming, or through persons falling from bridges, boats or piers or perishing in the water as a result of their own suicidal actions, the Coast Guard assumes that the primary responsibility for providing services and facilities for the recovery of such bodies is vested in and will be exercised by state, municipal or local authorities. Existing Coast Guard facilities and forces may be used, so far as such action may be taken, without undue jeopardy to the reasonable performance of other statutory functions.

Decisions as to whether a Coast Guard Auxiliary unit shall voluntarily render aid in any individual case of this kind rests with the owner/operator of assisting facility unless otherwise directed by the local Coast Guard Commander having operational control. In general, in any such case, personnel and equipment should not be sent to a point beyond the normal area of operations of the facility. Often the situation can be met by lending responsible civil authorities the dragging gear or other minor equipment which they may lack.

The careful preservation of human remains has important implications for accident investigations, legal requirements, and humanitarian purposes. The following guidelines will be observed:

1. On land, the remains of military personnel, or civilian personnel employed by the military, shall be removed only upon the approval of a medical officer. The remains of other civilian personnel should be removed in accordance with the applicable laws of the area.
2. At sea, the remains shall be recovered whenever possible and preserved for delivery ashore. The remains of military personnel, and civilian personnel employed by the military, shall be delivered to a medical officer of the parent service. The remains of other civilian personnel shall be delivered to the local coroner or medical examiner.

Normally, in every such case a delicate relationship with the public exists. Auxiliarists are cautioned to use tact and judgment, and to avoid every indication of apathy or indifference on the part of the Coast Guard or Auxiliary to the humanitarian considerations involved.

LEGAL ACTION SUBSEQUENT TO A SAR INCIDENT

Personnel engaged in SAR activities may become involved with certain legal actions after some incidents. Operating personnel are not expected to know the legalities of the questions which might be raised in such cases. If the primary purpose of SAR—the saving of life and property—is carried out with professional care, good judgement and common sense, operating personnel will be on firm ground if legal questions are later raised.

If legal actions or questions arise following an Auxiliary SAR assist conducted while under official Coast Guard orders, the Coast Guard legal staff shall be consulted prior to making a public statement.

HANDLING PRIVATE PROPERTY

The custody of private property such as boats, equipments, and other property which comes into the possession of an Auxiliarist while rendering assistance on official Coast Guard orders, should be turned over to the Coast Guard unit in operational control of the SAR case. If the assistance is rendered while under official Coast Guard orders in an inland area remote from the nearest Coast Guard unit, or while rendering voluntary assistance, such property should be turned over to the nearest state or local law enforcement authority for further disposition. Any information relative to time and location that the property came into the hands of the Auxiliarist, and any information relative to ownership of the property, should be provided.

CHARGES FOR SERVICES

No charges are to ever be made by any Auxiliarist involved in search and rescue for saving or assisting lives or property. Gifts or gratuities of any kind shall never be solicited, either directly or indirectly, from those assisted or in any way connected with the incident.

CHAPTER XIII

SAR DRILLS

Coast Guard Auxiliary Search and Rescue drills are conducted for the purpose of preparing Auxiliarists to render that service to fellow boatmen that only practice and training can qualify a person to render. Through increased efficiency, unnecessary delays will be prevented, affording greater protection and skill in missions of Search and Rescue.

The procedures and techniques taught in the Auxiliary Search and Rescue Course are advocated in conducting all drill operations, however, conditions requiring the judgment and resourcefulness of the drill participants should be stressed.

Each Flotilla and Division should conduct two or more SAR drills each season. Individual Auxiliarists should practice the techniques discussed, until proficient, especially those involving the man overboard. Practice working together, form Flotilla teams and perfect all aspects of the SAR mission. Teamwork, as well as knowledge, is a prerequisite for success.

An Auxiliarist, as the Captain of his vessel, may encounter any of the situations discussed. The distress may not be identical but the basic principle outlined will enable him to properly perform the task with skill.

A simple SAR drill is one for a lost boat, which has been previously anchored, or begun drifting at a predetermined location, on a day when the sea is calm and the weather proper for the mission. Never risk personnel or property in weather or sea unsuitable for cruising.

Before any SAR drill, at any Auxiliary level, is conducted, other than the personal practice and perfection of individual techniques, *permission must be obtained from the cognizant Coast Guard authority*. Request for permission *must include* the following information in order to obtain approval:

1. Flotilla or Division Number desiring to conduct drill.
2. Date and time drill will be conducted and concluded.
3. Area drill is to be conducted within and Chart Number to be used.
4. Permission to use CG frequencies.
5. Name and call sign of control vessel.
6. Name of Auxiliarist in charge of drill.
7. Names of participating Auxiliarists, Facilities, Facility Numbers and Radio Calls.
8. Local Coast Guard units or facility invited to participate.
9. Drill procedure to be followed.
10. Objective sought by drill.
11. That notification will be made immediately to local SAR Coast Guard Officer in event of drill cancellation.

Permission is absolutely required in order to use 2670 khz or 157.1 MHz for the drill. The Flotilla Operations Officer should submit this request, through the Division Operations Officer, to the cognizant Coast Guard authority well in advance of the drill date requested.

The Division Operations Officer will coordinate exercises, when two or more Flotilla drills are desired on the same date, before forwarding requests to Coast Guard. He will immediately forward all properly submitted requests for drills to the Coast Guard with endorsement of recommendation for approval or reason for disapproval. Improper requests should be returned to the Flotilla with reason and not forwarded to the Coast Guard until correction is made. Corrected requests shall also be forwarded through the Division Operations Officer as original requests.

The crew for each participating SAR drill craft should include at least three. Complete instructions should be given to all participants in the drill, including the name of the Auxiliary Officer in charge, the name of the boat he will be aboard, and the boat's Auxiliary radio call. The period of the search, the time limit allowed for the drill, the concluding place of rendezvous following the drill, and the method by which they will be advised of the SAR mission; all should be items of instruction.

To effect realism, the nature of the distress, mission, or any details pertinent to that which is to be performed, will not be disclosed until the SAR drill craft are dispatched.

SAR drill problems may also be discussed at Flotilla meetings. Heaving lines with "monkey' fist" may also be made under the instruction of the Flotilla Member Training Officer at a regular meeting.

APPENDIX

GLOSSARY OF SAR TERMS

Aircraft Wreckage Locator: A record of all aircraft wreckage within a SAR area of responsibility. Consists of a visual plot of each wreckage on a map and referenced by number to an index file containing all pertinent data concerning the wreckage.

Air Interception: To effect visual or radar contact by a SAR aircraft.

Air Supply: The delivery by air of items to a drop or landing area.

Air Route Traffic Control Center: The principal facility exercising enroute control of flights within its area of jurisdiction. Approximately 26 such centers cover the United States. Each has communication capability to adjacent centers.

Area Responsibility: A designated area in which an activity is responsible for coordinating and controlling SAR operations.

Border Clearance: Clearances and inspections required to comply with federal, state and local agricultural, customs, immigration and immunization requirements.

Case: The special circumstances relating to particular persons or property requiring SAR operations.

Case File: Information relating to individual SAR cases compiled and maintained by RCCs.

Closed Mission: A mission which has resulted in the positive determination of the location of the search target and for which there exists no further requirement for rescuing the survivors or providing them with a means of survival.

Communication and Harbor Check: Contacting, by any means necessary, all persons and harbors which may have or obtain information concerning the location or status of missing or overdue surface craft.

Controlling Agency: An agency which has primary responsibility for a specific SAR mission and controls all operations incident thereto.

Coordination: The function of integrating efforts of SAR facilities for a concerted and harmonized execution of the SAR mission in an effective, economical manner.

Coverage Factor (C): Ratio of Sweep Width (W) to Track Spacing (S), or C = W/S.

Datum: The probable position of the distress incident or survivors, corrected for drift.

Ditching: Controlled landing of a distressed plane on water.

Ditch Heading: Course selected by pilot of distressed aircraft to make controlled landing on water.

Drop Zone (DZ): A specified area upon which pararescue personnel, equipment and supplies are dropped by parachute, or on which supplies and equipment may be delivered by free fall.

Equi-time Point: The point along the route at which the aircraft may either proceed to destination or return to departure base in the same amount of time.

Escort: A rescue aircraft accompanying other aircraft in flight as a precautionary measure so that immediate SAR may be provided if necessary.

Extended Communication Search (EXCOM): Contacting, by any means necessary, all agencies along a given route or in a given area that were not contacted by the Preliminary Communications Search and which may have or obtain information concerning the location or status of a SAR objective.

Facility: Any craft or device used to effect SAR operations.

False Alert: An incident or mission which is later proven false due to the lack of a valid objective.

Flotation Gear: Equipment utilized to provide survivors with flotation on water, such as airborne liferafts.

Foam Path: A path of fire extinguisher foam laid by vessels on the ditching course to assist aircraft forced to ditch at sea.

Freefall: (1) Personnel parachute jump in which a static line is not used and the parachutist pulls the rip cord; (2) Aerial delivery of supplies or equipment without the use of a parachute.

Ground Interrogation: The process of interviewing various personnel in the field to obtain or verify any pertinent data concerning an incident.

Homing: A technique of arriving over a SAR objective by keeping an aircraft headed toward that point by reference to radio, Loran, radar or similar devices.

Incident: Any situation which requires notification to, and alerting of, SAR facilities and which may require SAR operations.

Incident Classification: Three phases in which an incident may be classified or progressed according to the seriousness of the incident and its requirement for rescue service.

a. *Uncertainty Phase*: Doubt exists as to the safety of a craft or its personnel because of lack of information concerning its position, or because of knowledge of possible difficulties.
b. *Alert Phase*: Apprehension exists for the safety of a craft or its personnel because of a continued lack of information concerning its position or progress or because of definite information that serious difficulty would be unavoidable.
c. *Distress Phase*: Immediate assistance is required because of a continued lack of information concerning the position or progress of the craft or because definite information has been received that craft or its personnel are threatened by grave or imminent danger.

Incident Processing: The procedure of receiving, evaluating and classifying incident reports; procuring and evaluating additional data; alerting and assigning mission control when rescue service is required; or terminating the incident if it is determined to be false or not requiring rescue service.

Identification, Friend or Foe (IFF): A system of identification of aircraft which carry a special responder beacon.

Inland SAR Region: The inland areas of Continental United States, except waters under the jurisdiction of the United States and the State of Alaska.

Interception: The dispatch of a rescue aircraft to locate, intercept, and escort an aircraft whose operating efficiency has been impaired.

Joint Rescue Coordination Center: An installation staffed by supervisory personnel, from more than one participating service, and possessing sufficient facilities to direct and coordinate all available search and rescue facilities within a specified area.

Jumpmaster: The assigned airborne qualified individual who controls parachutists and droppable supplies from the time they enter the aircraft until they exit.

Land Search: The search of terrain by earth-bound personnel.

Last Known Position (LKP): The last position received from an aircraft or the last position at which the aircraft was positively sighted, and identified by a ground observer.

Liaison File: A file maintained by all RCCs containing complete information (names of organizations, key personnel, how contacted, available facilities, area of operation, etc.) on all agencies within their area of responsibility who are capable of assisting rescue operations.

Lightline: Light beacons placed in a line to assist aerial navigation.

Lines of Communication (LOC): All the routes, land, water and air, which connect an operating military force with a base of operations, and along which supplies and reinforcements move.

LORAN: An abbreviated name for a long-range electronic navigation system which uses the time divergence of pulse type transmission from two or more fixed stations.

Maritime SAR Region: The waters subject to the jurisdiction of the United States; the territories and possessions of the United States (except Canal Zone and the inland area of Alaska) and the high seas as shown on the chart of the National SAR Plan.

Marking Panel: A sheet of material of distinctive color or design displayed by ground troops to signal their position, progress, or other information to friendly aircraft.

Meteorological Visibility: The maximum range at which very large objects such as land masses or mountains can be seen.

Mission: Any situation which requires the dispatch of SAR facilities. A mission exists when the requirement for SAR operations has been determined, mission responsibility has been assigned to the appropriate Mission Coordinator and SAR facilities have been dispatched.

Mission Coordinator: Official designated by a SAR Coordinator for coordinating and controlling a specific SAR mission.

Mission Control: See SAR Operational Control.

Mission Log: A record maintained by the Mission Coordinator of all operational activity pertaining to one specific SAR mission.

Mission Ready Equipment: All equipment carried on SAR aircraft and equipment maintained by rescue team personnel which is to be used primarily to aid in the survival and/or rescue of distressed personnel.

On-Scene-Commander (OSC): Official who controls SAR operations and communications at the scene of a distress mission.

Operational Control: See SAR Operational Control.

Operations Log: A record maintained by all rescue coordination centers, of all operational activity.

Orbit: A precautionary procedure in which a SAR aircraft(s) maintains position over a given point(s) somewhere along the proposed route of a "target" aircraft(s), and maintains communications with "target" aircraft(s) in the event SAR service is required.

Overseas SAR Region: Overseas unified command areas (or portions thereof not included within the Inland Region or the Maritime Region.)

Paradrop: Aerial delivery of personnel, supplies or equipment by parachute from an aircraft.

Pararescue Team: A group of five men specially trained and qualified to penetrate to the site of an incident by land or parachute, render medical aid, accomplish survival methods and rescue survivors.

Point of Safe Return: The most distant point along the planned route from which an aircraft may safely return to its point of departure, or alternate airport, with required fuel reserve.

Precautionary Mission: Any mission in which rescue facilities are dispatched so they are immediately "on the scene" in the event rescue service is required.

Preliminary Communication Search (PRECOM): Contacting through normal communication facilities all agencies along a given route or a given area which may have or obtain information concerning the location or status of a SAR objective.

Probability of Detection (P): Chances of sighting a given SAR target, expressed as a percentage, under existing conditions.

Radius of Action (R/A): The maximum distance that an aircraft can fly from its base before returning to the same or alternate base and still have designated margin of fuel.

Regional SAR Coordinator: The person responsible for coordinating and, as appropriate, directing SAR operations in a SAR Region.

Rescue: The removal of survivors from the site of a disaster or hazard to a place of safety.

Rescue Control: See SAR Operational Control.

Rescue Coordination Center (RCC): A primary SAR facility suitably staffed by supervisory personnel and equipped for coordinating and controlling SAR operations in a Region, Sub-Region or Sector as defined by the National SAR Plan.

RCC Controller: The officer on duty in a rescue coordination center (RCC).

Rescue Cover: The deployment of rescue facilities over a given area.

Rescue Support: Providing SAR assistance for a specific SAR mission.

Rescue Team Commander: The senior ranking rescue team member present where ever rescue team personnel are deployed.

Responsible Agency: The agency which is responsible for or has primary interest in the prosecution of SAR operations within a given area or for specific SAR missions.

SAR Alert Notice (ALNOT): The notification given to interested agencies that an aircraft is overdue.

SAR Alerting Post: An agency designated to serve as an intermediary between a person reporting an aircraft in distress and a rescue coordination center.

SAR Alert Status: Personnel and equipment immediately available and operationally ready to render SAR service.

SAR Alert System: The procedures by which personnel and equipment are scheduled and maintained on alert status to insure operational readiness.

SAR Alert Warning: The notification given to interested agencies that an aircraft position or arrival report is overdue.

Search: A systematic reconnaissance of a defined area, such that all parts of the area have passed within visual or electronic surveillance.

Search and Rescue (SAR): The employment of available personnel and facilities in rendering aid to persons and property in distress.

Search and Rescue Coordinator: The person responsible for coordinating and, as appropriate, directing SAR operations in a SAR Region, Sub-Region or Sector.

Search and Rescue Coordination: See Coordination.

Search and Rescue Mission: See Mission.

Search and Rescue Incident: See Incident.

Search and Rescue Operations: All actions pertaining to the prosecution of a SAR incident or mission from the time of initial notification until the incident or mission is terminated.

Search and Rescue Operational Control: The temporary functions of control exercised by SAR Coordinators, SAR Mission Coordinators, and On-Scene-Commanders over assisting SAR forces for the purposes of prosecuting a specific SAR mission.

Search and Rescue Region: The Inland, Maritime or Overseas SAR Region as defined in the National SAR Plan.

Search and Rescue Sector: A geographic subdivision of a SAR Sub Region.

Search and Rescue Sub-Region: A geographic subdivision of a SAR Region.

Search Pattern: A systematic plan of search craft's tracks over a search area to assure complete and uniform coverage of an area.

Search Radius (R): A radius originating at the most probable position of the target at any specific time and having a length equal to the total probable error position plus a safety factor to ensure complete coverage.

Sector SAR Coordinator: The person responsible for coordinating and, as appropriate, directing SAR operations in a SAR Sector.

SITREP: Situation Report. A special message format to report SAR information to a higher authority.

Sub-Regional SAR Coordinator: The person responsible for coordinating and, as appropriate, directing SAR operations in a SAR Sub-Region.

Submersible: A civilian submarine or underwater vehicle.

Sweep Width (W): A mathematically expressed measure of detection capability.

Supply Mission: The delivery of equipment and

supplies to ground rescue teams for purposes other than aiding survivors.

Suspended Mission: A mission in which SAR units have been dispatched and search has been conducted, but due to uncontrollable circumstances such as unfavorable climatic conditions, exhaustion of information leads, thorough search with negative results, SAR operations have been temporarily discontinued pending further developments.

Track Spacing: The distance between adjacent search tracks.

Water Lights: Water actuated lights laid in a path along the ditch heading to assist a pilot in ditching a distressed aircraft.

SWEEP WIDTH W FOR VISUAL SEARCH

Values for W given in Nautical Miles

Meteorological Visibility in Nautical Miles	Life Rafts				Small Boats (Less 30')					Small Boats (30' to 60')					Small Boats (60' to 90')					L Ve	
Hundreds Ft. Altitude	Surface	5	10	20	Surface	5	10	20	30	Surface	5	10	20	30	Surface	5	10	20	30	Surface	5
1	.7	.7	.8	.8	.7	.7	.8	.8	.8	.7	.8	.9	.9	.9	.9	.9	.9	1.0	1.0	1.0	1.5
3	1.0	1.2	1.8	1.8	2.5	2.0	2.3	2.9	3.0	3.5	2.8	2.9	3.1	3.2	3.9	3.2	3.3	3.3	3.4	5.0	4.0
5	1.4	1.6	1.6	2.7	2.7	2.2	2.7	3.2	4.0	4.2	3.0	3.6	4.2	4.3	5.0	4.2	4.5	4.7	4.7	6.0	7.0
10	1.8	1.8	2.1	3.6	3.9	3.5	4.2	4.5	5.8	6.5	5.5	5.8	6.2	6.5	8.0	7.1	7.3	8.0	8.3	11.0	10.0
15	1.9	1.9	2.6	3.6	5.2	4.8	5.5	6.7	7.0	8.5	7.6	7.4	8.6	9.8	11.0	10.0	12.0	12.0	13.0	14.0	13.0
20	2.0	2.1	2.8	3.6	5.3	5.1	6.2	6.8	7.1	8.6	8.2	9.0	9.6	10.0	12.0	12.0	12.5	13.0	13.5	15.0	15.0
30	2.2	2.3	2.9	3.6	5.5	5.9	7.0	7.0	7.1	8.7	9.5	11.0	11.0	12.0	12.5	12.5	13.0	13.5	14.0	17.0	17.0
40	2.2	2.4	2.9	3.6	5.6	6.0	7.1	7.1	7.2	8.9	10.0	11.0	12.0	12.5	13.0	13.0	14.0	14.5	15.0	17.0	17.0
50	2.2	2.4	3.0	3.6	5.7	6.0	7.2	7.2	7.3	9.0	10.0	12.0	12.5	13.0	13.5	13.5	14.5	15.0	15.5	20.0	21.0

WHITECAP CORRECTION FACTORS

WIND (KNOTS)	0	10	15	20	25	30	40	50	60
RAFTS	.8	1.0	.9	.7	.5	.2	.1	—	—
SMALL BOATS	.8	1.0	.9	.7	.5	.3	.2	.1	—
SHIPS	.9	1.0	1.0	.9	.8	.7	.6	.4	.2
DYE MARKER	.9	1.0	1.0	.9	.6	.4	.2	—	—
SMOKE	.8	1.0	.8	.6	.4	.2	.1	—	—

VALUES FOR W FOR VISUAL AIDS (Based on 20 miles

Daytime:
- Dye Marker - 4 miles (reducing to nil in h
- Mirror - 8 miles
- Orange Smoke - 12 miles (greatly reduced in h
- White Smoke - 16 miles (greatly reduced in h

Nighttime:
- Very Light - 24 miles
- Float Light - 20 miles
- Mk. 13 Flare - 22 miles

Figure 6

SWEEP WIDTH W FOR VISUAL SEARCH

Values for W given in Nautical Miles

	Life Rafts				Small Boats (Less 30')					Small Boats (30' to 60')					Small Boats (60' to 90')					Large Vessels				
...de ...tude	Sur-face	5	10	20	Sur-face	5	10	20	30	Sur-face	5	10	20	30	Sur-face	5	10	20	30	Sur-face	5	10	20	30
	.7	.7	.8	.8	.7	.7	.8	.8	.8	.7	.8	.9	.9	.9	.9	.9	.9	1.0	1.0	1.0	1.5	1.5	1.5	1.5
	1.0	1.2	1.8	1.8	2.5	2.0	2.3	2.9	3.0	3.5	2.8	2.9	3.1	3.2	3.9	3.2	3.3	3.3	3.4	5.0	4.0	4.1	4.1	4.2
	1.4	1.6	1.6	2.7	2.7	2.2	2.7	3.2	4.0	4.2	3.0	3.6	4.2	4.3	5.0	4.2	4.5	4.7	4.7	8.0	7.0	7.3	7.4	7.5
	1.8	1.8	2.1	3.6	3.9	3.5	4.2	4.5	5.8	6.5	5.5	5.8	6.2	6.5	8.0	7.1	7.3	8.0	8.3	11.0	10.0	10.2	11.0	11.3
	1.9	1.9	2.6	3.6	5.2	4.8	5.5	6.7	7.0	8.5	7.6	7.4	8.6	9.8	11.0	10.0	12.0	13.0	13.0	14.0	13.0	15.0	16.0	16.2
	2.0	2.1	2.8	3.6	5.3	5.1	6.2	6.8	7.1	8.6	8.2	9.0	9.6	10.0	12.0	12.0	12.5	13.0	13.5	15.0	15.0	16.0	17.0	17.5
	2.2	2.3	2.9	3.6	5.5	5.9	7.0	7.0	7.1	8.7	9.5	11.0	11.0	12.0	12.5	12.5	13.0	13.5	14.0	17.0	17.0	17.0	18.0	18.5
	2.2	2.4	2.9	3.6	5.6	6.0	7.1	7.1	7.2	8.9	10.0	11.0	12.0	12.5	13.0	13.0	14.0	14.5	15.0	17.0	17.0	18.0	19.0	19.0
	2.2	2.4	3.0	3.6	5.7	6.0	7.2	7.2	7.3	9.0	10.0	12.0	12.5	13.0	13.5	13.5	14.5	15.0	15.5	20.0	21.0	21.0	21.0	21.5

WHITECAP CORRECTION FACTORS

...DES)	0	10	15	20	25	30	40	50	60
	.8	1.0	.9	.7	.5	.2	.1	—	—
...ATS	.8	1.0	.9	.7	.5	.3	.2	.1	—
	.9	1.0	1.0	.9	.8	.7	.6	.4	.2
...ER	.9	1.0	1.0	.9	.6	.4	.2	—	—
	.8	1.0	.8	.6	.4	.2	.1	—	—

VALUES FOR W FOR VISUAL AIDS (Based on 30 miles visibility)

Daytime:
- Dye Marker - 4 miles (reducing to nil in heavy seas
- Mirror - 8 miles
- Orange Smoke - 12 miles (greatly reduced in high winds)
- White Smoke - 16 miles (greatly reduced in high winds)

Nighttime:
- Very Light - 14 miles
- Flost Light - 20 miles
- Mk. 13 Flare - 22 miles

Figure 6

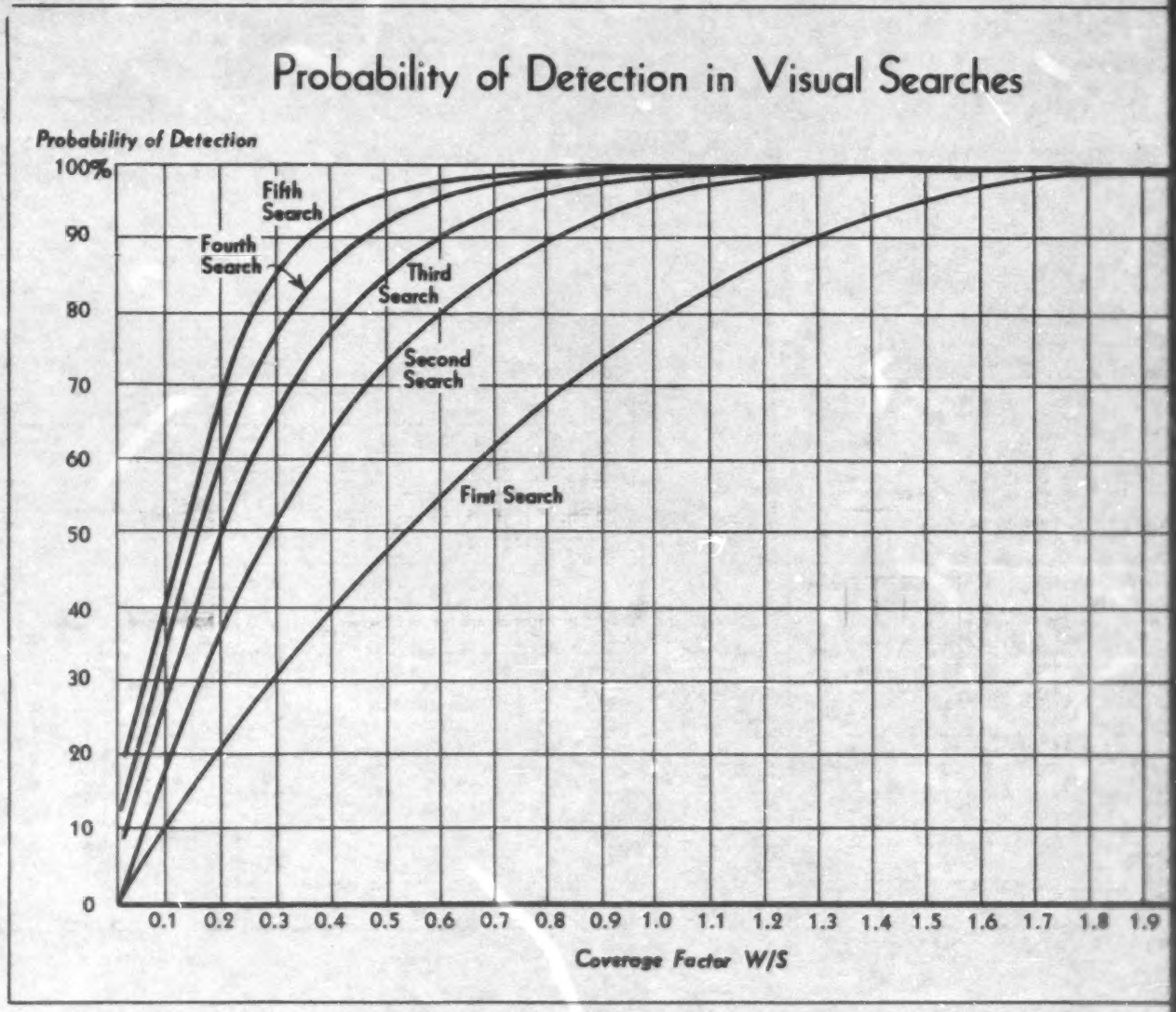

Probability of Detection in Visual Searches
Probability of Detection
100%
90
80
70
60
50
40
30
20
10
0
Fifth Search
Fourth Search
Third Search
Second Search
First Search
0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0 1.1 1.2 1.3 1.4 1.5 1.6 1.7 1.8 1.9
Coverage Factor W/S

Figure 7

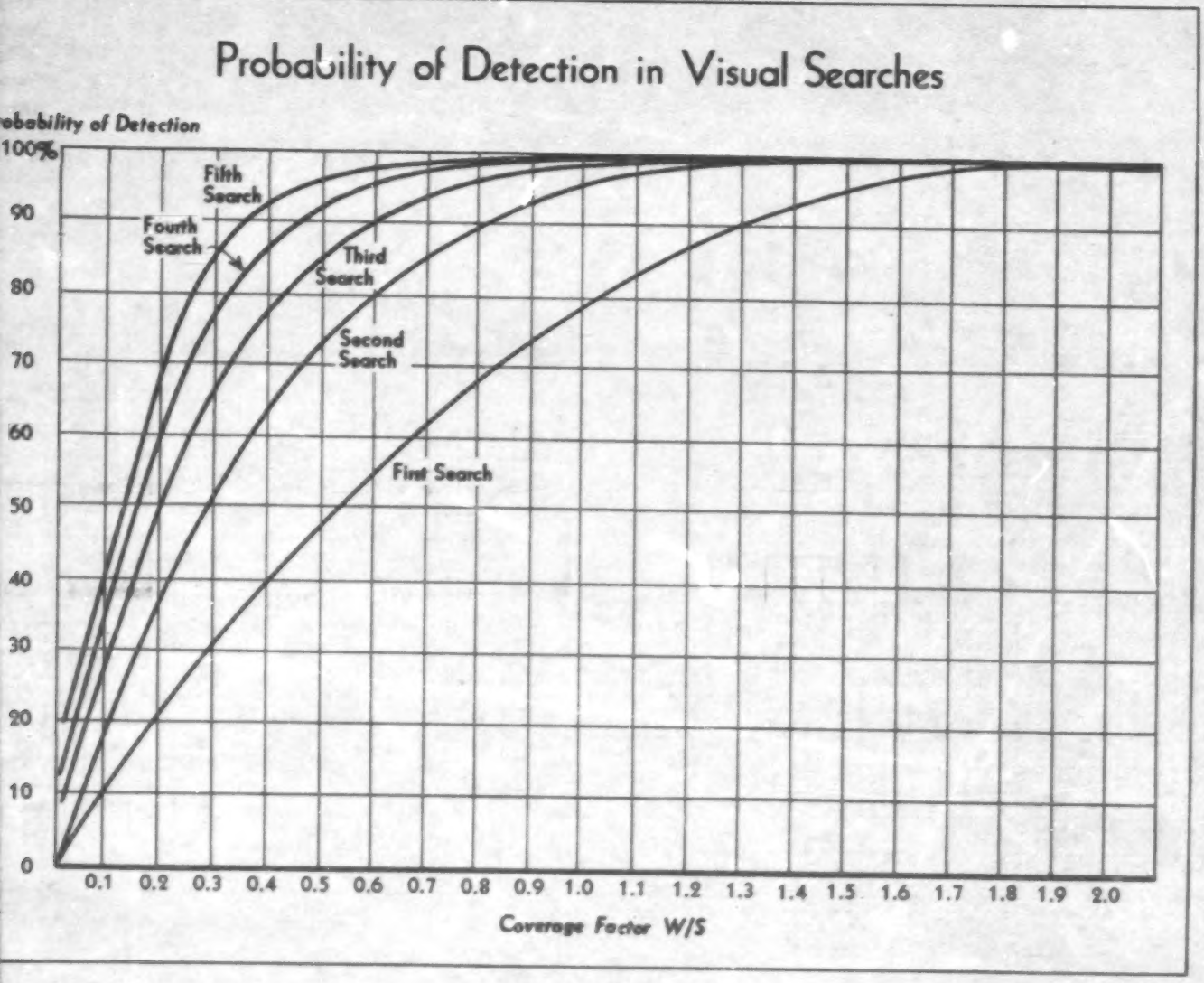

Probability of Detection in Visual Searches
obability of Detection
100%
90
80
70
60
50
40
30
20
10
0
Fifth Search
Fourth Search
Third Search
Second Search
First Search
0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0 1.1 1.2 1.3 1.4 1.5 1.6 1.7 1.8 1.9 2.0
Coverage Factor W/S

Figure 7

VELOCITY OF WIND CURRENT IN MILES PER DAY

BEAUFORT FORCE OF WIND	WIND SPEED IN KNOTS	WIND CURRENT IN MILES PER DAY
1	1-3	2
2	4-6	4
3	7-10	7
4	11-16	11
5	17-21	16
6	22-27	21
7	28-33	26

Figure 8

RELATION OF DIRECTION - WIND CURRENTS TO WIND DIRECTION

LATITUDE	DIVERGENCE OF WIND CURRENT FROM WIND DIRECTION
NORTH OF 10° N	30° TO THE RIGHT
10° N TO 10° S	DOWNWIND
SOUTH OF 10° S	30° TO THE LEFT

Figure 9

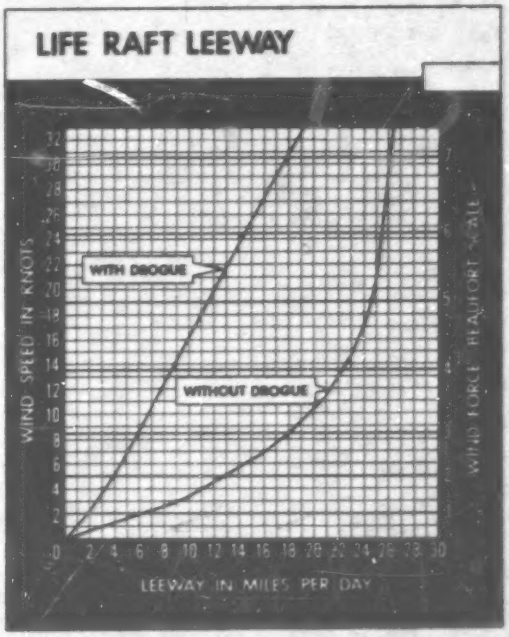

LIFE RAFT LEEWAY
WIND SPEED IN KNOTS
WIND FORCE BEAUFORT SCALE
WITH DROGUE
WITHOUT DROGUE
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30
LEEWAY IN MILES PER DAY

Figure 10

APPENDIX

DETERMINING WIND SPEED FROM SEA CONDITIONS

Wind Speed in Knots	Sea Conditions
0 to 1	Sea smooth and mirror-like
1 to 3	Scale-like ripples without foam crests
4 to 6	Small, short wavelets; crests have a glassy appearance and do not break
7 to 10	Large wavelets; some crests begin to break, occasional white foam crests
11 to 16	Small waves becoming longer; fairly frequent crests
17 to 21	Moderate waves, taking a more pronounced long form; many white crests; some spray
22 to 27	Large waves begin to form; white crests everywhere; sprzy
28 to 33	Sea heaps up, breaking wave crests blown in streaks; spindrift appears
34 to 40	Moderately high waves of greater length; edges of crests break into spindrift; foam is blown in streaks along the wind
41 to 47	High waves; dense streaks of toppling foam; crests, excessive spray
48 to 55	Very high waves with long overhanging crests, resulting foam patches blown in dense white streaks along the direction of the wind; surface of the sea is white, tumbling waves, visibility reduced
56 to 63	Exceptionally high waves that may obscure small boats and ship; sea completely covered with long white patches of foam along direction of the wind; edges of the wave crests blown into froth; visibility reduced
64 and above	Air filled with foam and spray; sea completely white with driving spray; visibility much reduced.

APPENDIX

WIND BAROMETER AND WEATHER

Wind Direction	Sea Level Barometer Readings: Inches–Millibars	Weather Indications
SW to NW	30.1 to 30.2 or 1019 to 1023–steady	Fair, slight temperature changes.
SW to NW	30.1 to 30.2 or 1019 to 1023–rising rapidly	Period of fair, followed by rain.
SW to NW	30.2 or 1023 and above–stationary	Continued fair, little or no temperature change.
SW to NW	30.2 or 1023 and above–falling slowly	Slowly rising temperature and a brief fair period.
S to SE	30.1 to 30.2 or 1019 to 1023–falling slowly	Rain within 24 hours.
S to SE	30.1 to 30.2 or 1019 to 1023–falling rapidly	Wind speed increasing, rain within 12 to 24 hours.
SE to NE	30.1 to 30.2 or 1019 to 1023–falling slowly	Rain in 12 to 18 hours.
SE to NE	30.1 to 30.2 or 1019 to 1023–falling rapidly	Increasing wind, rain within 12 hours.
E to NE	30.1 or 1019 and above–falling slowly	In summer, with light winds, rain may not fall for several days; in winter, rain within 24 hours.
E to NE	30.1 or 1019 and above–falling rapidly	In summer, rain probable within 12 to 24 hours; in winter, rain or snow with increasing winds, will often set in when the barometer begins to fall and the wind sets in from the NE.
SE to NE	30.1 or 1019 or below–falling slowly	Rain will continue 1 to 2 days.
SE to NE	30.0 or 1016 or below–falling rapidly	Rain, high wind, followed within 36 hours by clearing.
S to SW	30.0 or 1016 or below–rising slowly	Temporary period of clearing.
S to W	29.8 or 1009 or below–falling rapidly	Severe storm imminent followed within 24 hours by clearing and in winter by cold.
E to N	29.8 or 1009 or below–falling rapidly	Severe northeast gale and heavy precipitation; in winter, heavy snow followed by a cold wave.
Shifting W	29.8 or 1009 or below–rising rapidly	Clearing and colder.